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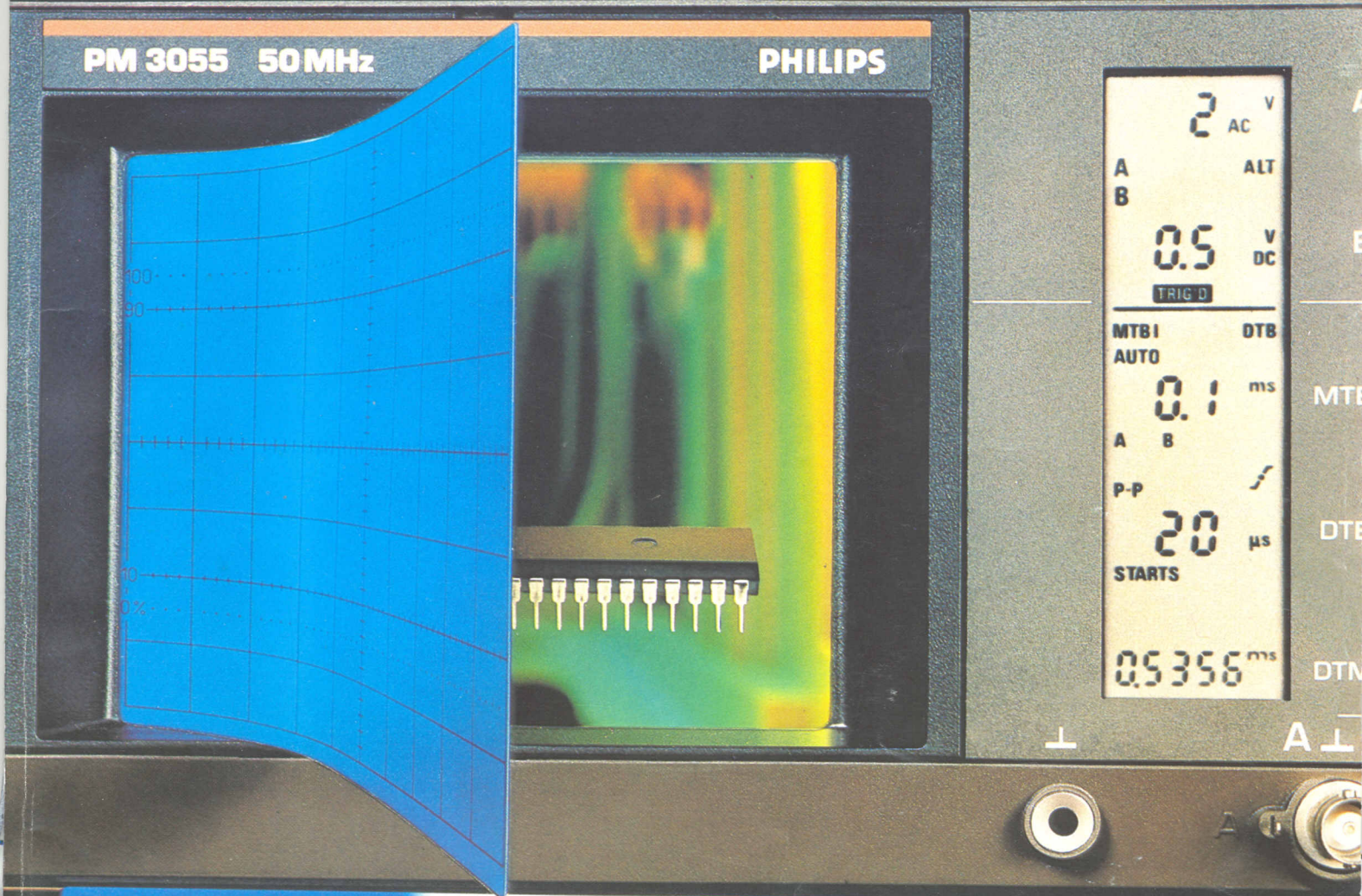
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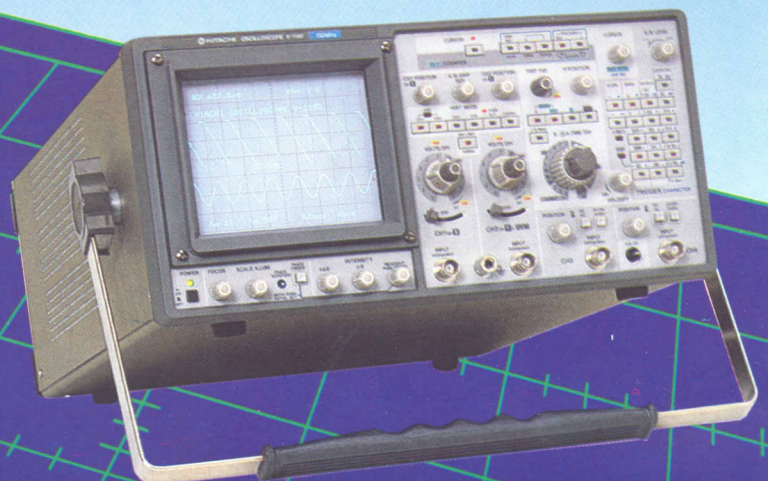
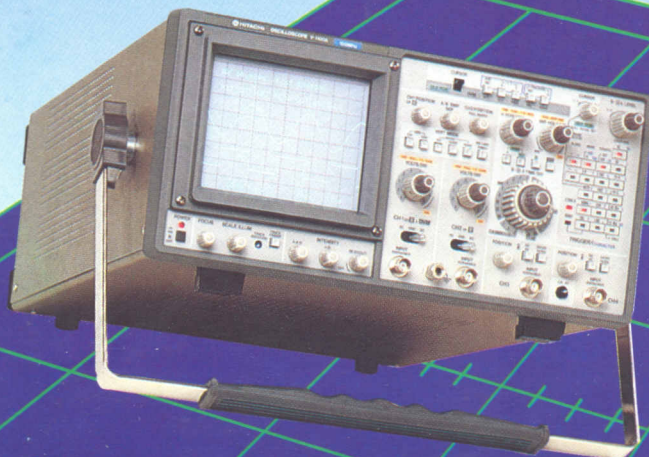
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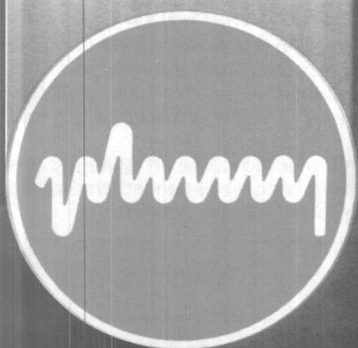


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THE SAIMC NOTICE BOARD

RUSTENBURG BRANCH

Brian White wishes to thank all those who participated in setting up the show stands and those who helped make the SAIMC exhibition stand a success.

It is noted that Brian has gone into hibernation during the cold period. We hope you enjoy your well earned rest Brian and look forward to having you back again.

JOHANNESBURG BRANCH

There will be no meeting in July because of the school holidays. Friends and colleagues are reminded of our social evening at Greensleeves, on 17 July, at R30 per head. Please contact Di Wight for bookings and more information.

Our next monthly meeting will be on 12 August. Previous meetings have been well attended and we look forward to seeing you all after the holidays.

RICHARDS BAY

Welcome back to the helm of the Richards Bay SAIMC Branch John. Hope you feel well rested after your leave and ready to promote our cause.

Future events of interest to note:

30 July – Level and other measurement – sponsored by Weil Electronics.

3-7 August – The Natal Trade Fair is being held in Durban.

27 August – Data acquisition – an evening sponsored by T.E.C.

1 October – Magnetic flow meters – sponsored by SA Liquid Meters.

'MODERN MEASUREMENT TECHNIQUES' SYMPOSIUM

The SAIMC and SAIEE held a successful symposium on Modern Measurement Techniques on 26 May at Mintek. Approximately ninety delegates attended. An interesting, active discussion was held at the conclusion of the symposium, with participation of the attendees. Papers will be published in the SAIMC Journal during the next few months.

THE NEGRETTI AWARD

Institute members are reminded that this is an annual award presented for the best paper delivered at an Institute Branch meeting. To be considered for this prestigious award, please contact your local Branch Chairman who will welcome the presentation of suitable papers and advise you about the award entry procedures.

NOTA BENE

☐ The Council's Formal Dinner on 11 November. Details to be announced in next issue.

☐ Institute ties available from the Secretary, Di Wight at R18 inclusive.

☐ URGENT – Technicians, have you registered? If not, contact the Board of Control for registration of Engineering Technicians. Telephone (011) 838-5721/2/3.

INSTRUMENTS AND ELECTRONICS 88

The Institute's next biennial exhibition is scheduled for 3-6 May 1988. Exhibitors can contact Di Wight, telephone (011) 802-5145, for further details regarding stand bookings and further particulars.

The previous exhibition held in 1986 was an outstanding success, both from the point of view of exhibitors and visitors.

DURBAN BRANCH

All members and friends are welcome to attend our meetings.

Please note the following events:

19 August – A panel discussion – Suppliers vs Users

30 September – A presentation on productivity, by Johan Buys

28 October – A paper on control, by Peter Shiels,
Venue: Blue Waters Hotel, time: 7.30 for 8.00 p.m.



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COVER

Philips new PM 3055 medium-frequency oscilloscopes family constitutes a breakthrough in price/performance, together with unprecedented ease of operation and a high degree of application versatility.

The most striking differences between the new PM 3055 family and existing scopes are seen at a glance at the front panel. Controls can be read from left to right, and from top to bottom as in a book.

Rotary knobs for control settings have been replaced by 'up-down' switches for setting the attenuator timebase and delay time multiplier, for ease of operation and long life.

Function selection is by means of pushbutton switches, kept to a minimum by use of sequential operation.

Operation is further simplified by a 'green button' for auto-setting, under microprocessor control, so any signal which is connected will be shown clearly on the screen regardless of parameters. This avoids the need for time-consuming manual setting procedures. The autoset function covers all major scope functions: amplitude, timebase and triggering.

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Random sampling – beating the Nyquist limit on DSOs

Information from
Nicolet, USA

The digital oscilloscope advantages of better resolution, permanent storage and computer compatibility are now well established. Unlike its analog counterpart, a digital oscilloscope can capture and store a single, non-repetitive event or transient. However, in this transient capture mode, the speed of the digital oscilloscope is limited by its ADC.

Although ADC speeds are advancing rapidly, 100 MHz 8-bit converters are only now becoming widely available.

At 100 MHz an ADC can successfully digitise signals with frequency components up to the Nyquist limit of 50 MHz providing the minimum of two sample points per cycle. For computer analysis of signals this Nyquist limit is practicable, but for visual inspection of signals, a minimum of ten points per cycle is more realistic.

Techniques such as interpolation between points or 'dot-joining' can help, but these methods make assumptions about the signal which may not be true. Thus, in single shot or 'realtime' mode, digital oscilloscopes are restricted to the analysis of signals in the 10 MHz region or below. For many applications in electronics, this is a serious handicap. However, the majority of these applications involve repetitive waveforms: indeed, any analog oscilloscope relies on this fact to produce a useful display. For such repetitive signals, the speed of digital oscilloscopes can be extended dramatically using a technique known as random interleaved sampling.

Sequential sampling

The sampling technique is not new and very high speed analog oscilloscopes have used variations of the method for years. The simplest method, sequential sampling, involves taking a sample of the signal during each sweep. By successively increasing the trigger-to-sample delay a composite picture of the

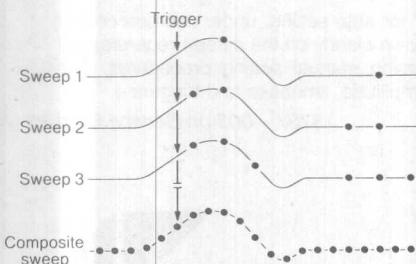


Figure 1. Sequential sampling: the time (ΔT) from the trigger to sample, is progressively lengthened by 2 ns until a composite sweep is built. The time to build one sweep is 2 ns $\times$ the memory length.

waveform is produced (Figure 1). However, on a digital oscilloscope with a large memory size this becomes impractical. For example, with a 4K memory, 4096 sweeps would be required to produce one display! Two further disadvantages are the need to resynchronise the digitiser clock prior to each sweep and the lack of pre-trigger capability.

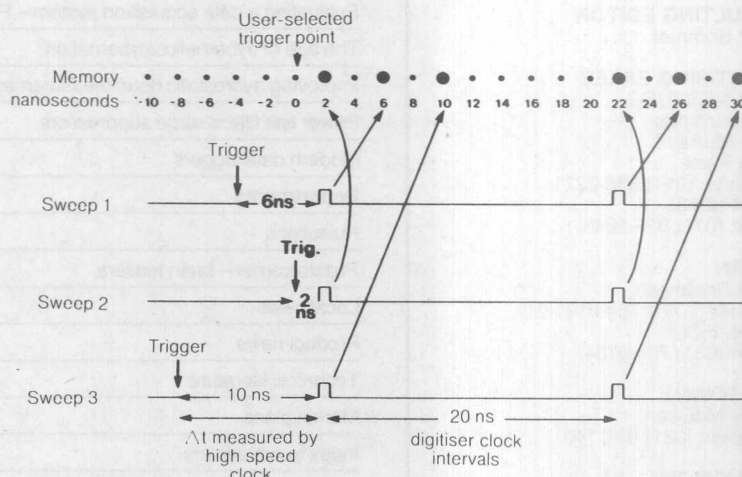


Figure 2. Random interleaved sampling: the time (ΔT) between the trigger and the digitiser clock is measured with a high speed clock. This example shows successive ΔT s at 6, 2, and 10 ns. Data is positioned in memory in relation to the trigger point.

Random sampling

Random interleaved sampling offers a practical solution to these problems while retaining most of the digital oscilloscope advantages. In this method, the digitiser is allowed to run at its maximum rate taking as many samples as possible on each sweep. Ideally, the oscilloscope should be equipped with the highest realtime digitisers consistent with its intended price/performance niche. As each trigger occurs, the time between the trigger and next digitiser clock pulse is measured. This time interval is used to route the data to its correct place in memory. No attempt is made to resynchronise the digitiser. On the contrary, the random relationship between the trigger pulse and the digitiser clock is essential to successful operation. Furthermore, there is no restriction on the trigger position: pre-trigger operation is still possible.

Figures 2 and 3 serve to explain the

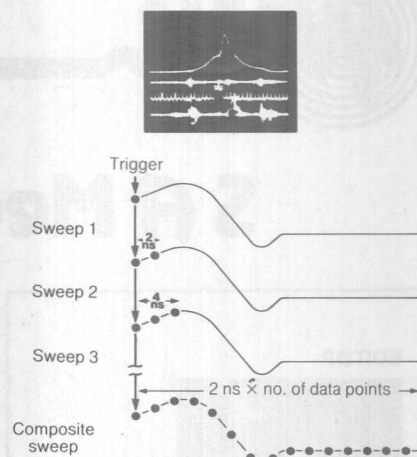


Figure 3. The screen display related to Figure 2 is built up over a number of sweeps.

random interleaved sampling method. In this example, the timebase has been set to 500 MHz (2 ns/point) by the user, but the maximum realtime rate of the digitiser is only 50 MHz. The time (ΔT) between the trigger and the next digitiser clock pulse is measured on each sweep and used to route the data

to memory (Figure 2). Thus, successively sampled sweeps are located in memory at their correct position relative to the user-defined trigger location (Figure 3). In this example the minimum number of sweeps required to complete the composite waveform would be 10 (500/50). However, the number is typically greater than this since the same ΔT is likely to be encountered on several sweeps. For example, the Nicolet 4094 (with 4175 plug-in) typically takes twenty sweeps at the timebase setting of 500 MHz, which, with its 16K memory, is 800 times faster than sequential sampling.

Timing accuracy

Clearly, as with all sampling techniques, the most critical element is the timing accuracy when measuring ΔT .

Several methods could be used. For example, if a sawtooth waveform were

Continued on page 8

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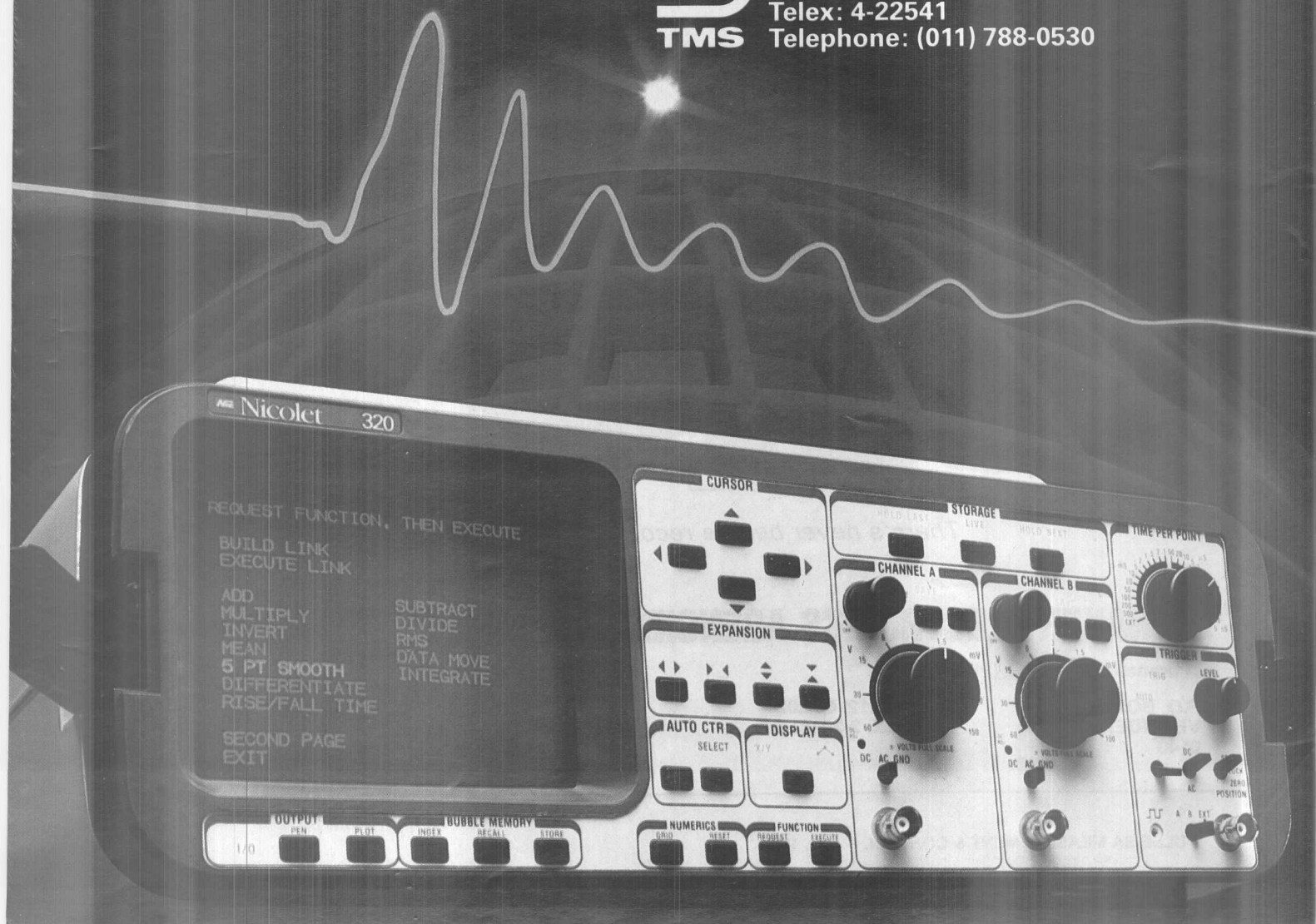
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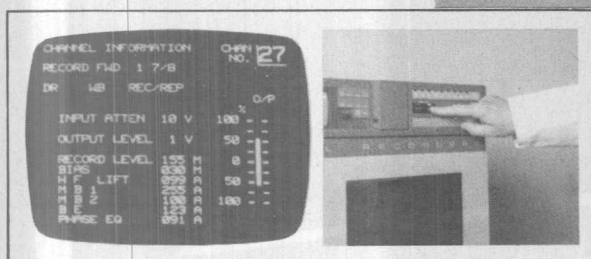
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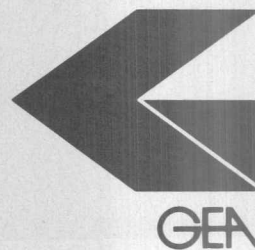
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DSO update

Digital storage oscilloscopes can obtain more and better data

Marc Brenner and Robert A. Oblack
Tektronix Inc, USA

Digital storage oscilloscopes (DSOs) are now maturing into moderately priced, general-purpose tools that both simplify measurements and provide insight into a variety of phenomena.

And yet, at the same time as DSO prices are dropping, measurement capability is rising; higher sample rates are making it easier to capture data; peak detection extends capture to spikes as narrow as 2 ns; special trigger mode 'save-on-delta' simplifies capture of events outside user-defined limits; and nonvolatile memory keeps both waveforms and instrument setup conditions stored, even when DSO power is off.

Some DSOs even provide self-calibration to ensure stable performance under varying temperature conditions. And all of these advances are available in portable instrument having a mass of less than 15 kg.

In order to take advantage of the capabilities of these new DSOs, it is important to understand some basic facts about their operation and their special functions. To a large extent, these facts are an extension of standard oscilloscope concepts. The chief difference is the extension into the digital domain, an area that opens a whole new range of measurement and analysis possibilities.

Waveform digitising and storage

In the operation of these scopes, a continuous analog waveform, such as that viewed on a traditional oscilloscope, is broken into a set of discrete, time-ordered samples of amplitude. The instrument digitises these samples and stores them in memory as an array of digital data.

One immediate benefit is that this feature lets the instrument capture non-repetitive events, such as waveforms typical of mechanical testing, evoked biological responses, and laser-induced phenomena. On standard oscilloscopes, the displays for these events are often dim, and they fade quickly. But with a DSO, such transient events can be held in memory for redisplay as often and for as long a time as the operator desires.

Analysis is simplified by clear, stable waveform displays enhanced by screen cursors and built-in processing. For example, to measure time or amplitude differences, the operator positions cursor dots on the waveforms, and a micro-processor computes the positional differences, or delta measurements, and displays these values on the screen.

Amplitude and time resolution

Among the other possibilities is the transfer of waveform data to a computer for extensive analysis. Still, the success of any measurement depends first upon how well the DSO represents the original waveform. Here, the fundamental issues are resolution of amplitude and time, bandwidth, record length, and rate of display update (Figure 1).

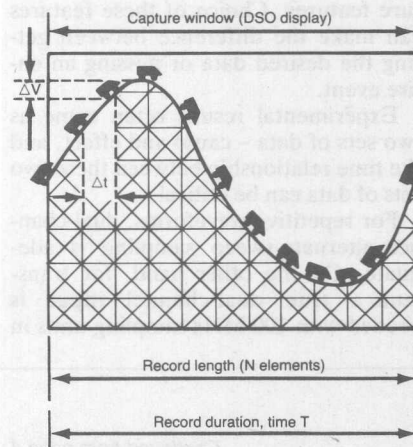
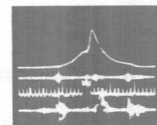


Figure 1. Key parameters for waveform digitising include: vertical resolution (smallest possible ΔV , defined by $1/(2^n - 1)$, where n is the number of digitiser bits); time resolution, or DSI, Δt , the smallest possible value of the expression $T/(N - 1)$; the record duration (T); and the record length (N). Additional terms used include the sampling rate ($1/\Delta t$) and the Nyquist frequency (half the sampling rate of the instrument). Each sample can be thought of as a roller coaster car of a size large enough to capture a significant portion of the signal. The vertical and time resolutions are the closest distances the individual cars can approach without interfering with each other.

Amplitude resolution is defined by the number of digitiser bits (number of quanta = 2^n , for n bits). For example, 8-bit digitising is typical; and this provides a signal amplitude resolution of 1 part in 256, or 4 mV for a 1 V full-screen setting. Selection of other amplitude scale settings results in more or less resolution, just as different settings will do on a standard oscilloscope.

More digitiser bits provide higher overall resolution, but there are practical limits. One of these limits is the cost



of higher technology that is tied to another limit: the speed of conversion.

Digital conversion of a waveform amplitude sample takes a finite amount of time. The sampled data must be held and converted before another sample can be digitised. This fact basically defines realtime sample rate which determines how closely samples can be spaced on the waveform. Thus at 20-MHz sample rate the time resolution is 50 ns and at 100 MHz the resolution becomes 10 ns.

Equivalent-time storage bandwidth

The realtime sample rate also determines the bandwidth of a transient or single-shot stored waveform. Ideally, the realtime rate is half the sampling rate (by the Nyquist criterion), providing 2 samples/cycle for a frequency element at the bandwidth limit (the Nyquist frequency). The Nyquist frequency is the highest frequency that can be defined by digitising; this frequency determines the amount of waveform detail that can be retained.

Neither the digital bandwidth nor the time resolution has to be constrained by realtime sampling. On repetitive waveforms, for example, equivalent-time sampling boosts the sampling rate severalfold (Figure 2).

To achieve these results, the oscilloscope makes multiple acquisitions to construct the waveform. This type of data acquisition requires that the wave-

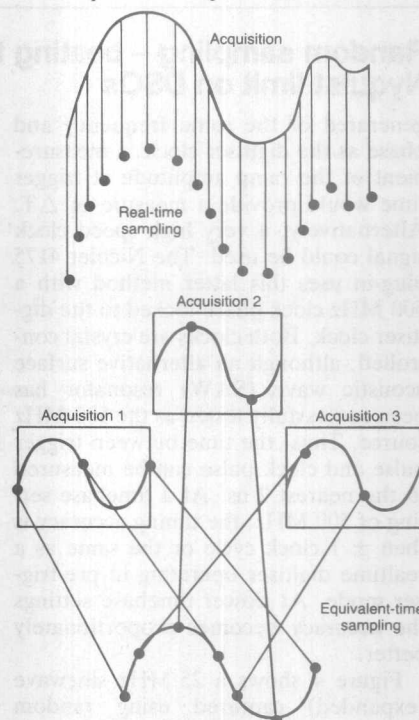


Figure 2. Two sampling methods are used in DSOs. Realtime sampling is needed for transients; equivalent-time methods allow buildup of denser sampling on repetitive waveforms.

form be repetitive for synchronous triggering of each acquisition. Individual acquisitions are still sampled at the DSO's realtime rate, but sampling is interspersed on individual acquisitions. Thus, 100 MHz sampling is, in effect, multiplied over several acquisitions.

The bandwidth limit for DSOs that use equivalent-time sampling is essentially the bandwidth of the analog input stages of the instrument. More than anything else, this is a property of economics. As a result, a low-cost DSO might have a 60 MHz equivalent-time bandwidth, while a medium-priced DSO having the same sampler would have a 100 MHz bandwidth.

Just as in selecting an analog oscilloscope, it is first necessary, to specify a bandwidth that is adequate for the waveforms the user expects to acquire, then specify the record length and the time-resolution considerations.

For equivalent-time sampling, time resolution is related to the waveform memory length, often called the record length. For example, the Tektronix 2230 DSO provides a record of 4K (4096 samples, 0 through 4095). At its fastest unmagnified time-base setting (50 ns/div for 40 div), equivalent-time resolution is 0.5 ns (2 000/4 095). By contrast, the 2430 DSO has a shorter record (1024 elements) but a faster sweep rate, resulting in a 0.05 ns resolution.

In the capture of transient waveforms, a longer record has some advantages. For this work, realtime sampling must be sustained over long-duration

transient decays. On the other hand, a shorter record is more than adequate for short transients or for a few cycles of a repetitive waveform.

A shorter record allows faster processing because it has fewer points to consider. In addition, a shorter record provides the fast display update rates needed for viewing waveform changes with minimum latency (time delay after a stimulus before observable action occurs) between experiment adjustments and display response. As an alternative to fast stored display-update rates, especially when long records are concerned, newer DSOs provide both stored and realtime analog scope displays.

Capture capabilities

In waveform capture, bandwidth, record length, and digital resolution all are important fundamental considerations. A second set of considerations that follow immediately can be equally important. These are properties of capture features. Choice of these features can make the difference between getting the desired data or missing an entire event.

Experimental results often come as two sets of data – cause and effect, and the time relationship between these two sets of data can be critical.

For repetitive waveforms, dual-channel alternate-sweep sampling is adequate. On the other hand, for transients a true dual-channel input is needed with 100 MHz sampling units in

each channel, giving the exact time coincidence between two captured transients.

Pre- and post-triggering allow advance or delay of data acquisition. The amount of advance or delay generally is limited to the record length. For catching pulse fronts, including pre-shoot or zeroing in on a secondary event immediately following a high-amplitude primary event, this technique is adequate.

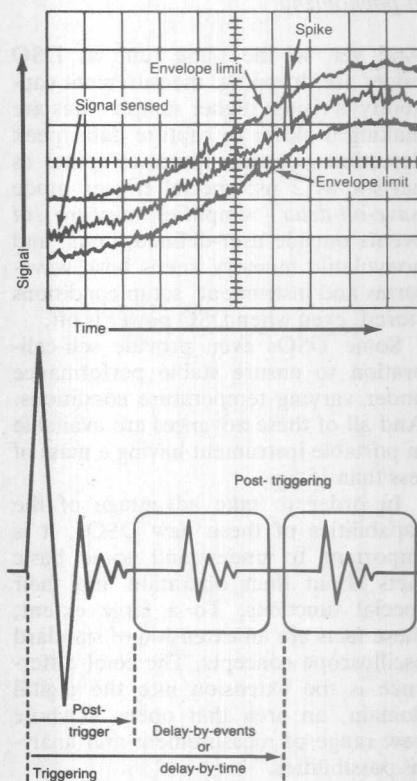


Figure 3. A save-on-delta mode: (a) capture of waveforms that exceed a preset envelope of limits during the time when the DSO is unattended; and (b) post-triggering allows capture of an event immediately following a main event by delaying the acquisition window. Time or event delay captures selected events.

'Delay-by-events' is essentially a trigger-counting device. This feature allows triggering on and capturing of one specific event out of a long string of events – e.g., the 15th pulse in a pulse string. The feature can be useful for zeroing in on logic faults and for after-shock or reverberation phenomena.

'Delay-by-time' is similar to 'delay-by-events', except that acquisition is delayed by a selected amount of time. A related feature, 'delta delay', measures the delay between two events. This feature is useful for studying stimulus-response latency.

'Save-on-delta' (Figure 3) allows unattended DSO monitoring for waveform excursions beyond preset limits. The feature greatly simplifies capture of unpredictable activity, such as power excursions or glitches, biosystem per-

Random sampling – beating the Nyquist limit on DSOs

generated of the same frequency and phase as the digitiser clock, a measurement of the ramp amplitude at trigger time would provide a measure of ΔT . Alternatively, a very high speed clock signal could be used. The Nicolet 4175 plug-in uses this latter method with a 500 MHz clock phase-locked to the digitiser clock. Both clocks are crystal controlled, although an alternative surface acoustic wave (SAW) resonator has been successfully tested as the 500 MHz source. Thus, the time between trigger pulse and clock pulse can be measured to the nearest 2 ns. At a timebase setting of 500 MHz, the timing accuracy is then ± 1 clock cycle or the same as a realtime digitiser operating in pre-trigger mode. At slower timebase settings the accuracy becomes proportionately better.

Figure 4 shows a 25 MHz sinewave (expanded) captured using random sampling at 500 MHz. Note that the realtime rate of the digitiser (50 MHz) would have provided only two points per cycle on such a signal: the theoretical Nyquist limit.

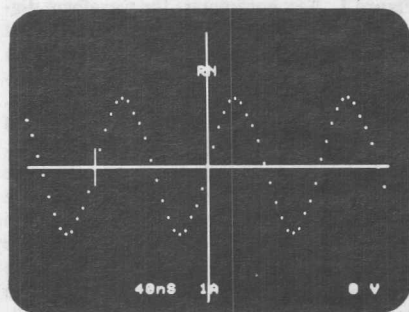


Figure 4. A 25 MHz signal measured with random sampling at 500 MHz. One cycle (40 ns) is measured from the small crosshairs to large cursor crosshairs.

The only digital advantage sacrificed in the random sampling mode is the ability to capture one-shot signals. However, signals can still be stored, expanded, manipulated, plotted or transmitted to external computers for analysis. Since the signals are, by definition, repetitive, signal averaging can be used to reduce noise and enhance dynamic range.

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turbations, reaction onset, or fatigue failures.

To use the 'save-on-delta' feature, the operator stores a 'waveform-limits' envelope when setting up the experiment. The instrument then automatically compares subsequent waveform acquisitions to the preset limits and stores any out-of-bounds activity. In addition, the instrument can record the time elapsed to event capture.

For low-speed activity, such as respiration, some chemical reactions, and seismic recordings, the 'roll mode' simulates a chart recorder. Waveform activity continuously rolls across the DSO screen with time, and sections can be saved selectively.

The x-y mode captures related sensor data for x-y plots. For example, one DSO channel can be acquiring pressure-

sensor output while the other channel is acquiring volume data. Both sets of data can then be used to construct a pressure-volume curve.

A DSO equipped with nonvolatile memory retains stored waveforms and even DSO settings after power has been turned off. This feature allows the operator to carry the DSO between experiment sites to collect waveforms or make comparisons. Moreover, with storage of front-panel settings, complex measurement sequences are simplified by being able to call up complete instrument set-ups from memory.

When it is available from the DSO's front panel, self-calibration is a great benefit to measurement accuracy and repeatability. For example, in the new DSOs, self-calibration is a single menu selection that calibrates input-channel

attenuations, gains, and offsets in about 10 s.

This capability makes it easy to compensate for varying environmental conditions. Self-calibration before each measurement minimises instrument drift that is inherent in tests made in the cool of the morning, then repeated in the heat of the afternoon.

Signal processing

Most DSOs feature some form of built-in signal processing. As a minimum, waveform-array searches and manipulation are needed for most basic acquisition techniques. Signal averaging and cursor-assisted measurements require additional processing.

Signal averaging applies only to repetitive waveforms and operates by computing an average waveform from a se-

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ries of acquisitions. This averaging reduces the amount of random, mean-zero noise. The process is so effective that low-level signals buried in noise can still be captured and 'cleaned up'.

In some implementations, signal averaging increases vertical resolution. For example, in the Tektronix 2430 DSO, 256 averages improve 8-bit resolution to 11 bits, with corresponding sensitivity increase to 200 $\mu\text{V}/\text{div}$.

Long-term signal-amplitude or phase variations are easily revealed with enveloping. The resulting envelope is also a convenient vehicle for quantitative analysis of signal variations.

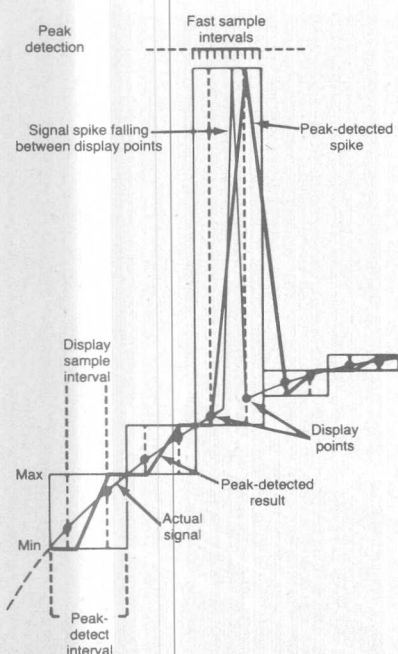


Figure 4. Fast sampling and storing of maximum and minimum values that are seen during any peak-detection interval permit the DSO to capture any signal spikes that occur in the period between normal display points.

Peak detection (Figure 4), an extension of enveloping, reveals narrow spikes that normally would fall between samples and be missed. To catch narrow spikes, some DSOs sample at a high rate, even on slow time-base settings. This treatment produces more samples than there are display points, but a sample-selection scheme ensures display of at least one point on spikes as narrow as the smallest sample interval.

A different approach takes advantage of analog peak-detection circuits. This approach extends detection to spikes as narrow as 2 ns.

The ability to add, subtract, and multiply is fundamental in the combination of waveforms. One example of this function is the calculation of the output of a power source. Other uses include the acquisition of baseline aberrations on one channel for subtraction from a signal acquired on another channel.

Among the built-in processing fea-

tures, cursor measurement is, perhaps, the most generally useful. Two cursors, seen as bright dots or crosses, can be moved around on the waveform for direct readout of amplitude and time differences. In addition, more-advanced DSOs include readout conversions to percent, decibels, or slope, for example.

Automated lab measurements

For some exploratory measurements, interactive use of a standalone instrument is desirable. On the other hand, many tedious procedures can benefit in both speed and repeatability from automated measurements. Such measurements can include those from varying stimuli or from different test subjects.

A system made up of just a small computer, such as an IBM 'PC', and a simple DSO opens a new level of measurement possibilities (Figure 5). Waveforms that have been digitised and stored in the DSO can be transferred to the computer. There, these waveform arrays can be processed to any degree or with any method the operator desires. To aid in this technique, some DSO manufacturers offer software tailored for most efficient waveform transfer from specific DSOs to specific computers.

In addition, DSOs that offer programmability provide a new level of automation. A computer disc can store any number of standard setups for transfer to a DSO when needed. And if programmable-stimulus instruments are added, laboratory systems can be assembled for fully automated data logging and analysis.

Still another possibility exists for DSOs with an RS232C interconnection. Since RS232C is the standard for modem telephone links, there is the possi-

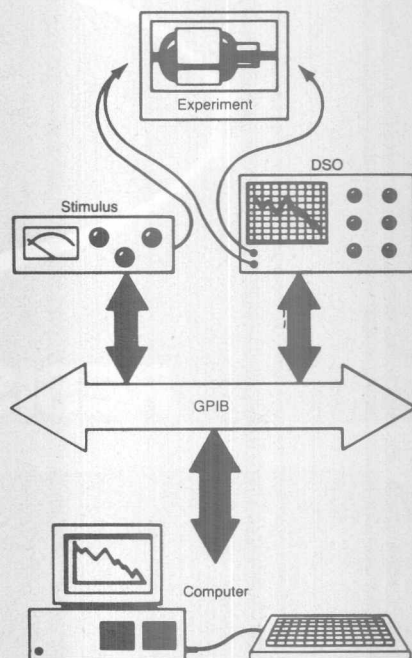


Figure 5. A general-purpose interconnect (IEEE-488 bus) allows transfer of DSO waveforms to a computer. A programmable DSO and stimulus source permit full automation of complex or repetitive test sequences.

bility for automating remote-site measurements. The remote DSO can be addressed and waveforms transferred over a phone line to a central laboratory for logging or processing.

An extension of this concept would permit combination of the calendar and clock functions of a computer with an auto-dial modem. This would provide the possibility for scheduling automated data capture and logging throughout the day, the night, and over weekends and holidays. □

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A new photoplotter

The model 3244 photoplotter from Gerber Scientific was introduced primarily to address the PC-based CAE market for interface to systems such as PCAD, RACAL-REDAC, CASE, SMARTWORK, and others, via a common 5 1/4" MS-DOS format floppy disc.

The model 3244 photoplotter is an important addition to the Gerber product line and allows design companies to now take advantage of a photoplotter at an affordable price. (Starting price R100 000 excluding GST). In fact, the monthly rental cost is less than what the average company currently pays for bureau generated artworks.

The model 3244 photoplotter boasts artwork masters with one 25 μm accuracy, plotted at speeds up to 170 mm/s with a maximum effective plotting area of 508 by 660 mm to accommodate large PCBs and standard PCB fabrication panel sizes.

The new OEH-Q optical exposure head offers the flexibility of two types of aperture wheels. One wheel is standard containing 34 fixed apertures and one optional containing 20 fixed apertures with the capability to

accommodate up to 10 additional interchangeable apertures. The number of apertures is increased further by having the lamp intensity controlled by software which allows drawing and flashing with the same aperture.

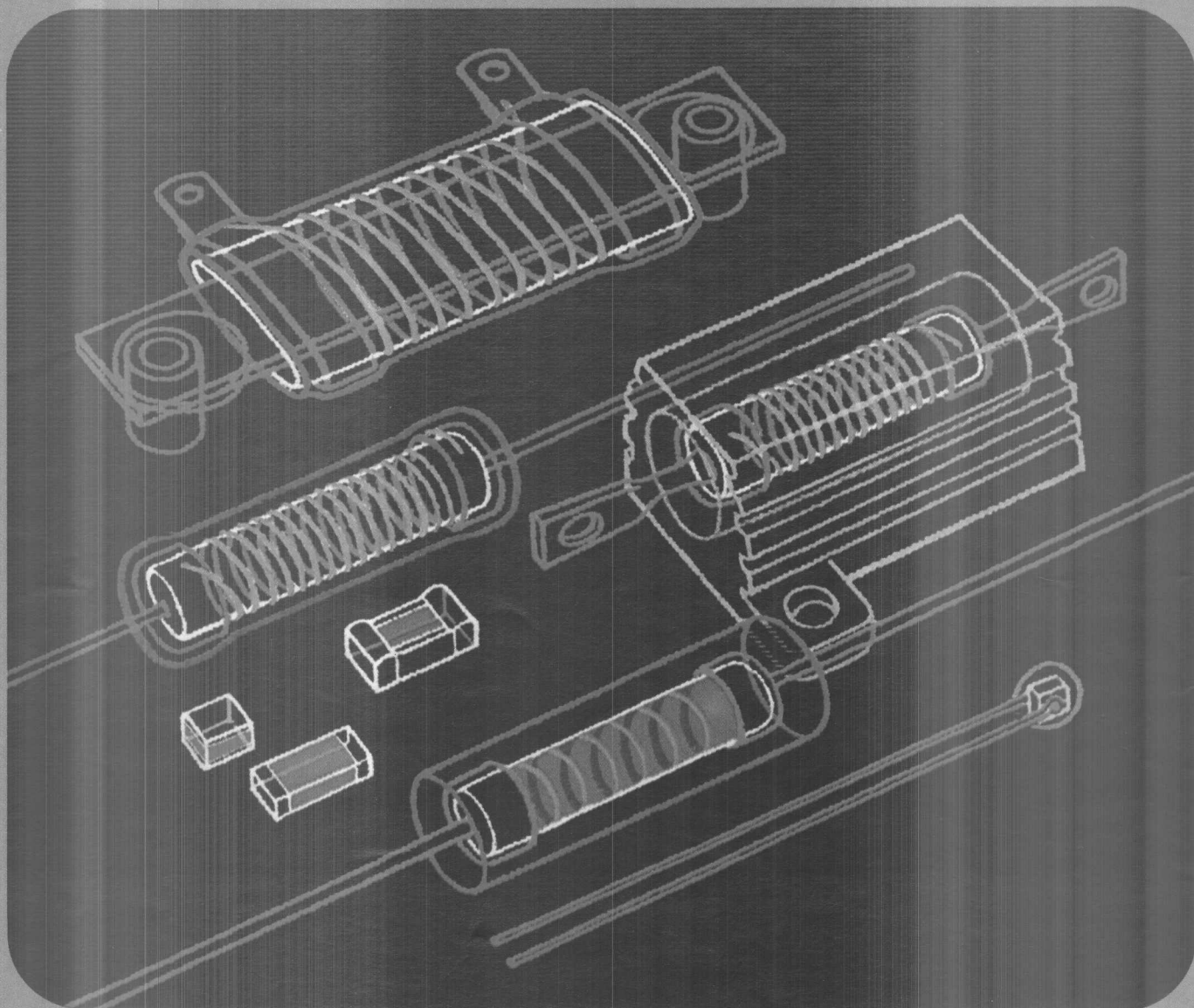
The flexibility of the model 3244 photoplotter is shown too in the ease of operation of the system: the operator simply selects a predefined aperture configuration; loads the 5 1/4" (PC-DOS) Gerber formatted plot disc; places the media on the plotting surface; and presses 'start'. The system is capable also of plotting from optional mag tape of RS232.

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Improved P²CCD design facilitates digital storage operation

Daan v.d. Meij and Hennie Rensink,
Philips Test & Measurement The Netherlands

Philips latest PM 3320 digital storage oscilloscope (Figure 1) provides much higher sampling rates than before with the maximum rate of 250 M-samples/s providing a 4 ns resolution. In addition, separate glitch-catching circuits detect spikes as short as 3 ns, and equivalent time sampling is also incorporated directly in the charge-coupled device (CCD), reducing component count and improving reliability.

The sampling rate improvement has been brought about by an improved design of profiled peristaltic CCD (P²CCD) which downconverts the incoming signal frequency to a level which can be handled by low frequency ADCs. This avoids the need for expensive flash converters and reduces the problems of aperture uncertainty.

The P²CCD functions by recording samples of the incoming signal at high frequency and reading them out at a much lower rate. Incorporation of the sampling gate now enables the P²CCD to be used at all timebase settings.

Use of a 12-bit ADC following the P²CCD improves resolution markedly. Leakage compensation and calculation accuracy considerations still leave a full 10-bit resolution – providing 1000 points vertically. Doubling the length of the P²CCD, compared to earlier models, combined with deeper memory facilities ensures a horizontal resolution of 4096 points in single-channel operation, 2048

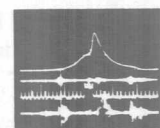
points per channel in dual-channel operation and at least 512 points per channel for single shots.

Analog shift register

A CCD is an analog shift register resembling a MOSFET with many gates. The information to be transported consists of a series of charge packets representing the incoming signal.

In its simplest form the CCD consists of a single-crystal silicon semiconductor with a row of electrodes or gates mounted on it. These gates are insulated from the semiconductor by a thin film of silicon oxide.

A typical device is shown in Figure 2 at the instant where the voltage on gate 1 becomes less than that on gate 2 which in turn becomes less than that on gate 3. The potential in the silicon under the gates is then as indicated. Plotting in the downward direction emphasises the character of a well. Free charge under gate 2 sees a potential minimum under



G = Gate

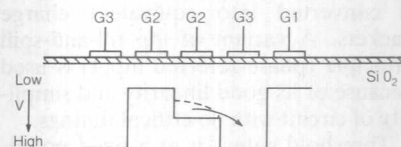


Figure 2. A CCD is essentially an analog shift register resembling a MOSFET with many gates.

gate 3 and so will travel there.

So, by the use of alternating voltages at a minimum of three sets of gates, it is possible to store and transfer the charges and keep them separate.

However, as CCDs increase in length with many gates, there are several limitations in operation:

- transfer inefficiency – some charge will be trapped at every transfer and after many transfers, this loss can be considerable;
- charge package size – the amount of charge that can be transferred and stored affects the signal-to-noise ratio;
- maximum transfer speed – this governs overall performance of the device; and
- leakage currents – thermal excitation within the CCD causes a leakage current which increases the charge packet while it remains in the CCD.

There are several different types of CCD: surface (SCCD), bulk (BCCD) and peristaltic (PCCD) devices. Each has its own advantages: speed, low transfer inefficiency or large charge handling capabilities.

Optimum combination

Long, fast CCDs that can store a lot of charge are required for application in a digital storage oscilloscope. The structure which provides this optimum combination is the P²CCD (profiled peristaltic charge-coupled device) which has been used for several years in Philips digital storage oscilloscopes.

However, several important improvements have recently been included:

- the number of gates is doubled with two identical P²CCDs on the chip, each with 256 gates and both sides multiplexed to obtain 512 memory cells;
- the input has a separate sample gate with flow-back threshold;
- the transfer section has been modified to obtain shorter gates with adjusted dope profile which allows very fast transfer and low transfer inefficiency, and narrower channels, resulting in lower gate capacitance;
- the output signal is increased by use of a separation gate; and
- the gates are now protected by a specially developed gate system which adds a very low capacitance to the pro-

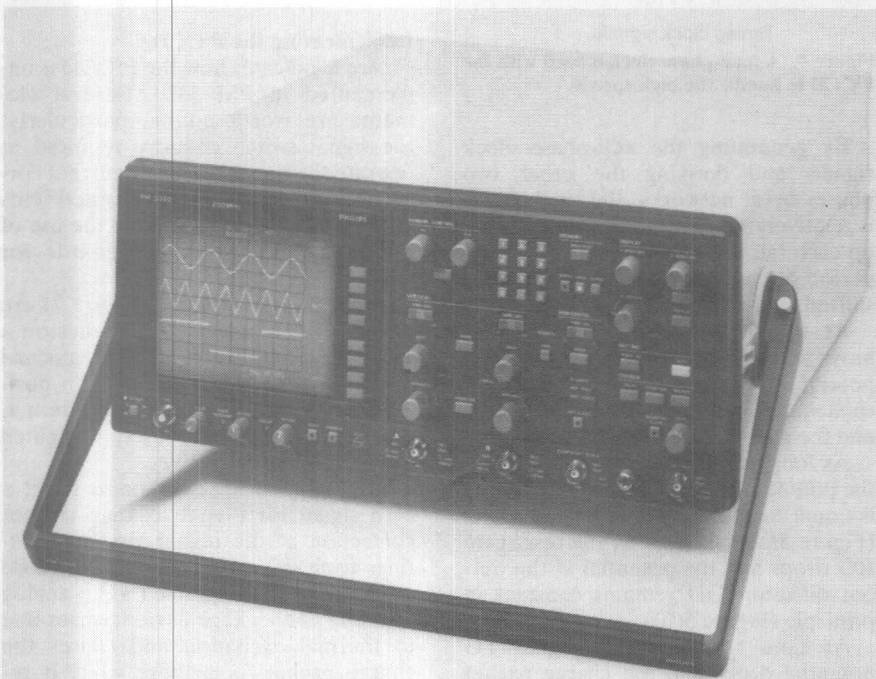


Figure 1. Philips PM 3320 digital storage oscilloscope achieves a maximum sampling rate of 250 M-samples/s for 4 ns resolution, using P²CCDs to downconvert the incoming signal frequency to a level which can be handled by a low frequency ADC.

tected circuit. Unprotected P²CCDs are very sensitive to electrostatic discharge.

Variation on fill-and-spill

The improved circuit functions as shown in Figure 3. At the input of the P²CCD, the analog signal to be sampled is converted into equivalent charge packets. A variant of the fill-and-spill principle (phase referred input) is used because of its good linearity and simplicity of circuit with no critical timings.

Threshold gate 1 is at a fixed potential. Signal gate 2 is at a bias potential higher than gate 1 and the signal to be sampled is superimposed on the bias potential. So, the 'bottom of the well' under gate 2 varies with the input signal.

In the fill period, the sample gate SG is low so the potential at source S, due to UB1, will be as the arrow in Figure 3(a) indicates. The potential under gates 1 and 2 will become equal to that at source S. Now there is free charge under gates 1 and 2 as indicated in Figure 3(a).

For the spill operation, the sample gate SG goes high (Figure 3(b)) and, due to UB1, source S goes up. When source S becomes higher than gate 1, no more charge is supplied. The surplus charge under gates 1 and 2 will flow back to source S.

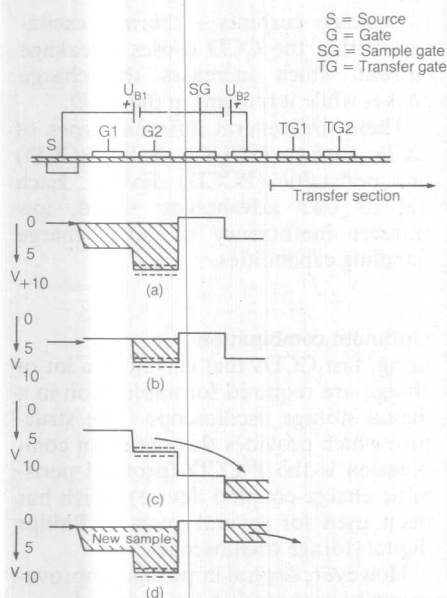


Figure 3. A variant of the fill-and-spill principle is used in the P²CCD to provide good linearity, simple circuitry and no critical timings.

The size of the locked-up charge packet under gate 2 is determined by the bottom of the well which is equal to the input signal at the moment of the rise of the sample gate.

By supplying a clock signal with a very short risetime (t_r is less than 2 ns), a very short sample period – a small part of t_r – is realised and a very wide bandwidth is obtained.

When the potential at the sample gate SG rises further, the charge will collect in the well caused by UB2 (Figure 3(c)).

If the sample gate potential declines, the sample will stay in the 'lift' until it gets to the transfer section (Figure 3(d)). In this way no charge can flow back to source S – forming a flow-back threshold – and the timing to the transfer section is less critical.

Four-phase clocking

In theory three gates per memory cell are sufficient but this requires a three-phase transfer clock which is difficult to realise for very high speed operations. In practice a four-phase structure is used (Figure 4).

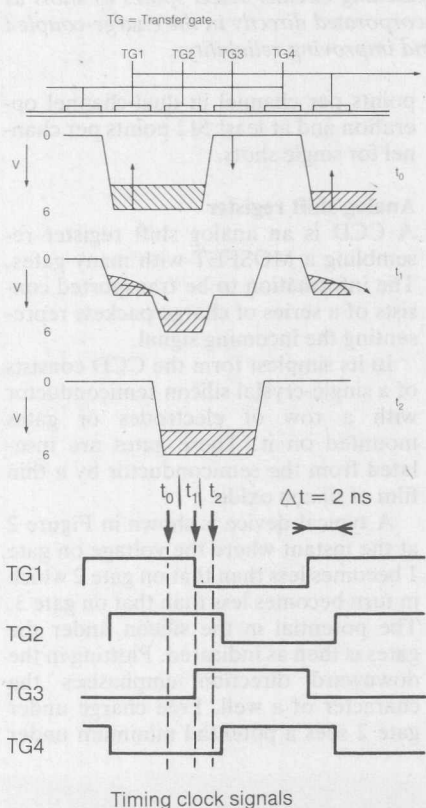


Figure 4. A four-phase clock is used with the P²CCD to handle the high speeds.

By generating the anti-phase clock signals and deriving the other two phases by dt networks, the total circuit is relatively simple. Transfer takes place on each fall of a clock signal; after each period of transfer gate 1, the sample is shifted over one memory cell.

At the output, the charge packets have to be converted into equivalent potentials (Figure 5). Here, the output capacitance consists of the marked area and the gate of the buffer FET.

As long as the reset gate RG is high, the potential at the output diffusion OD is equal to that on the reset drain RD (Figure 5(a)). At time t_1 , the reset gate RG drops and the potential at the output diffusion OD remains constant in principle (Figure 5(b)).

At time t_2 , the transfer gate TG potential drops and the charge packet will flow 'over' the separation gate GSP to the output diffusion OD (Figure 5(c)). This results in a change in poten-

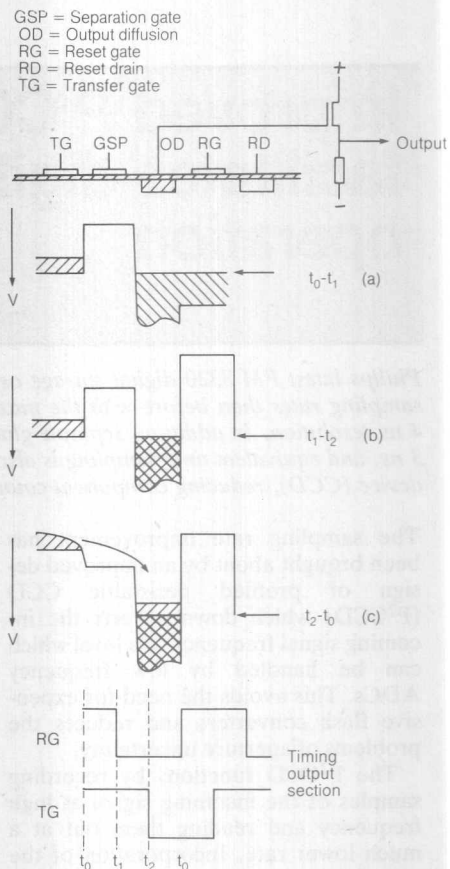


Figure 5. At the output of the P²CCD, the charge packets are converted into equivalent potentials. The output capacitance consists of the marked area and the gate of the buffer FET.

tial at the output diffusion OD. The value of the potential change is proportional to the size of the charge packet.

The result of this is that, at the output of the buffer FET, the potential is proportional to the sampled signal at the input.

Implementing the P²CCD

Figure 6 indicates how the P²CCD is implemented in PM 3320. Several elements are worth noting, particularly: the signal switch circuitry required to operate the device; leakage current correction for thermally generated currents: drop stabilisation; and the use of multilayer printed circuit boards for improved performance.

Signal switch circuitry (Figure 7) are very fast bipolar current switches on a thin film hybrid circuit. In normal mode, switches S1 and S2 are in position b but by setting them to position a, the peak detectors – used for glitch catching – become active.

The signal switches can also select a zero signal for digital leakage current correction at the higher timebase settings from 0.2 ms/div. In low timebase positions, this is corrected in an analog fashion. The leakage current arises due to thermal excitation and causes the charge packet to increase while it remains in the P²CCD.

For digital correction, the signal is first digitised and stored as a 'signal re-

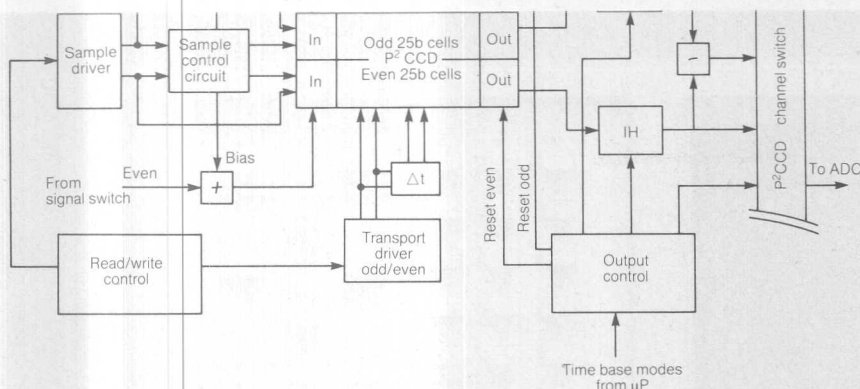


Figure 6. This diagram indicates how the P²CCD is implemented.

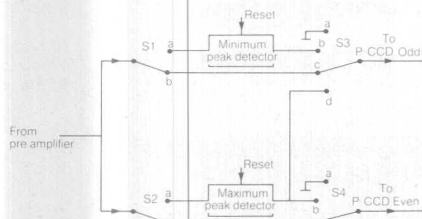


Figure 7. The signal switch circuitry required to control the P²CCD relies on very fast bipolar current switches on a thin film hybrid circuit.

cord'. Then switches S_3 and S_4 are set in position a and a 'zero record' made by sampling and digitising a zero signal. The zero record is digitally subtracted from the signal record. In the min/max mode, leakage correction is performed in a similar way.

Correcting for surplus charge

The fill-and-spill principle has the disadvantage that surplus charge does not

completely flow back (Figure 8). This surplus charge (a drop) under gates 1

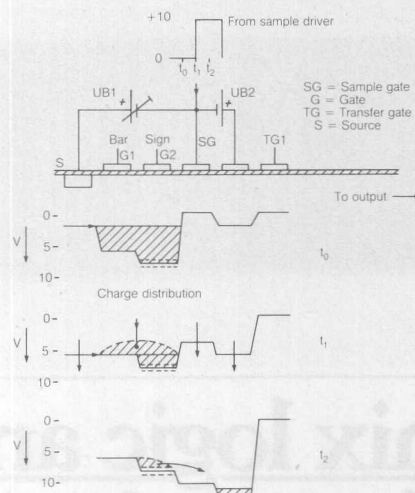


Figure 8. As can be seen, the fill-and-spill principle suffers slightly from surplus charge which can result in a bias level.

drop stabilisation circuit is shown in Figure 9.

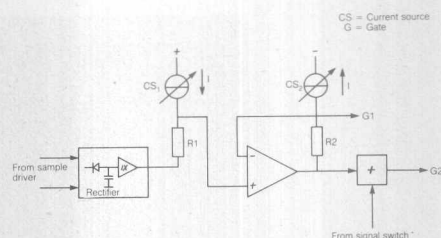


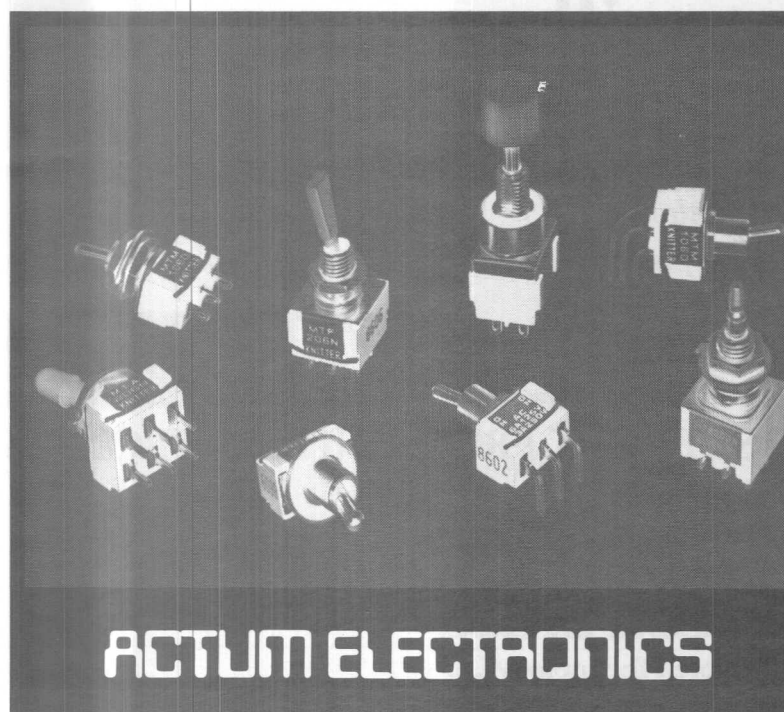
Figure 9. As the size of the surplus charge is generally consistent, it is possible to use a simple drop stabilisation circuit to compensate.

The low sample clock level is rectified and, after buffering, connected via resistor R_1 to the non-inverting input of an operational amplifier. The potential over resistor R_1 is adjusted with current source CS_1 . This potential added to the rectified sample clock level fixes the potential at threshold gate 1.

Current source CS_2 fixes the potential over resistor R_2 and so the adjustment of signal gate 2 with respect to gate 1. If the low sample clock level changes, then the potential at gates 1 and 2 will change equally and the drop will remain constant.

Final part of the P²CCD unit is the output circuit. A typical output signal is shown in Figure 10. Level 'a' is fixed by the reset drain at the output as shown in Figure 5(a). Capacitive coupling between the reset gate RG and the output diffusion OD results in level 'b' (see Figure 5(b)). Level 'c' is caused by the clocked signal and contains the input-signal information.

Continued on page 18



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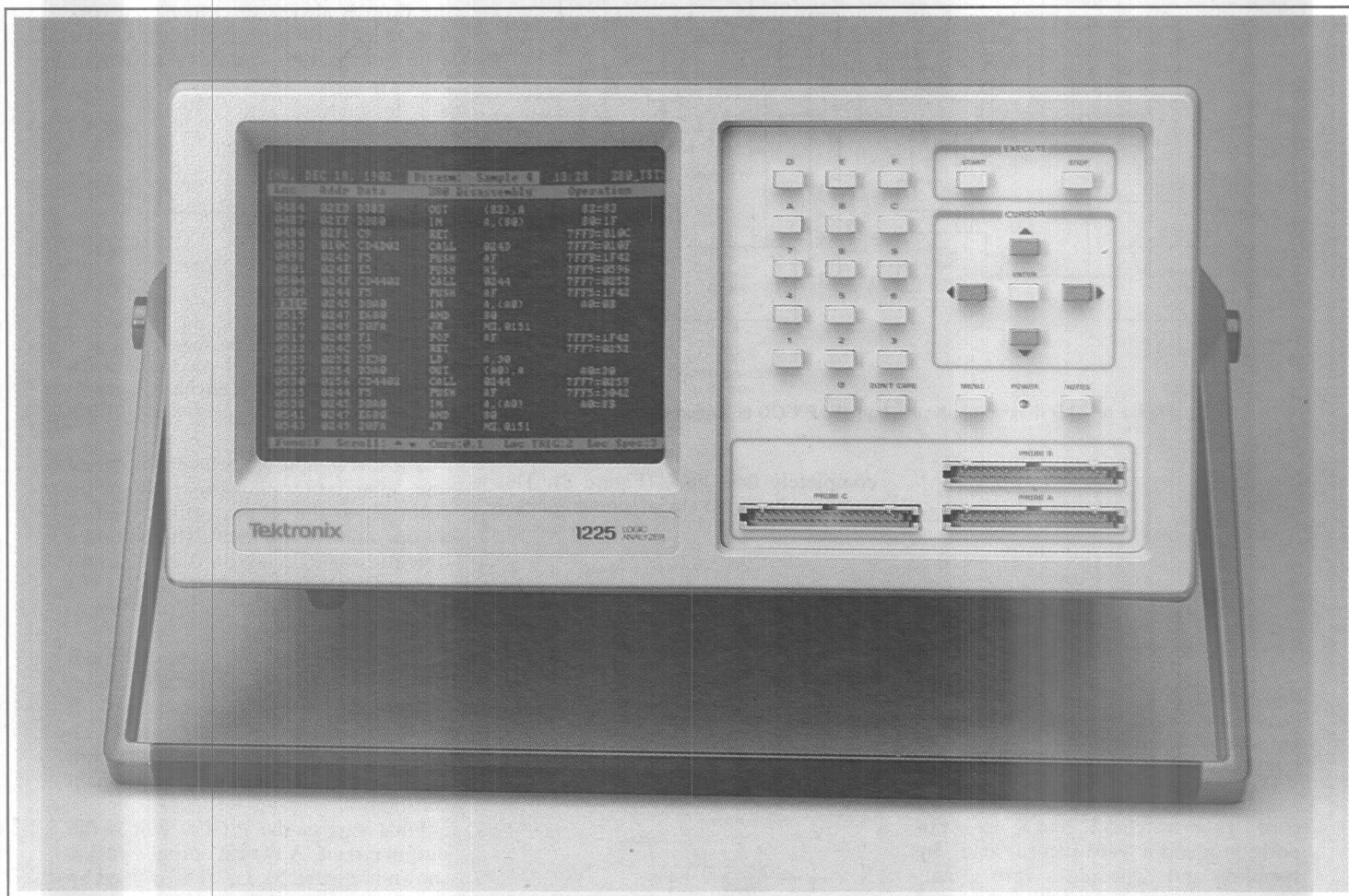
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Designing with high-speed ADCs

Avoiding layout and interfacing pitfalls

Robert E Leonard, for
Datel, USA

Understanding the fundamentals of layout in a precision, high-speed A/D converter is just as important, and sometimes as difficult, as knowing how to design the interface circuitry. Most data sheets will state certain precepts of layout or interface circuitry, but quite often the reasons behind the precepts are not included. As a result, proper design procedures are often not followed, and the device is blamed for not living up to its data sheet specifications.

The following article outlines design practices to help avoid A/D layout and interfacing pitfalls that can cost time and money. The two A/D architectures discussed include successive approximation and two-pass or subranging A/Ds. A third type, the dual-slope A/D, is also quite popular. However, it is better suited for slow-speed applications and thus will not be discussed here.

Grounding

Accurate converter systems begin with good ground management. System ground configurations will vary depending on the size of the overall system, the different magnitudes and locations of the system's analog and digital ground currents, and whether the converter's analog and digital grounds are connected together internally.

For many system designs, optimum performance is achieved when the analog and digital grounds are tied together at the ground plane beneath the converter (Figure 1), and brought back separately to the analog and digital power supplies. An analog signal voltage only has the integrity of its analog ground. When the analog and digital

grounds are connected at the power supplies, problems arise since noisy digital ground currents flow through, and contaminate, the analog ground.

In addition to the noise created, the amplitudes of these currents, multiplied by the impedance of the ground, could enter into the millivolt region, causing decreased A/D accuracy. When system requirements mandate the use of a common return to the power supplies for both analog and digital grounds, the converter should be located close to the power supplies. Also, to further minimise impedance-related problems, as large a conductor as possible should be used between the converter and the power supplies.

The extent to which accuracy is threatened by such noise sources is shown by the following example: for a 12-bit converter on a 10 V full scale range, a $\frac{1}{2}$ LSB of accuracy is equivalent to 1.22 mV. Therefore, if a 7 mV difference in ground exists throughout a system, a few LSBs of accuracy error will result.

Ground loops occur when analog and digital grounds are tied together at more than one location. For instance, a

ground loop might develop if the A/D's analog and digital grounds were connected inside the A/D and also connected by the designer at the power supplies (Figure 1). Noisy digital ground currents would then contaminate the analog ground.

System designs that use more than one converter can result in an unwanted situation – having more than one location in which analog and digital grounds come together. Here, the impedance between converters should be minimised by the use of a large ground plane.

For small systems, separate analog and digital ground return paths can then be run back from the ground plane to the separated analog and digital power supplies. A large system, however, may have other devices that produce large digital currents and create noise. A/Ds should be located away from these noise sources, to prevent the noise from being introduced into the ground plane beneath the converter. When the distance between the A/D's ground plane and power supplies needs to be long, large digital currents from other circuitry within the system should be returned close to the digital power supply. If this does not provide the desired performance, a separate analog return for the converter may be required. This can be done by using local, isolated power supplies (Figure 2).

Decoupling capacitors

Decoupling capacitors on power supplies are essential to prevent noise spikes and oscillations from degrading converter performance. Noise spikes from digital switching, or the use of switching power supplies, can create problems. Power supply rejection of converter products appears excellent at first glance. For example, the power supply rejection specification of the

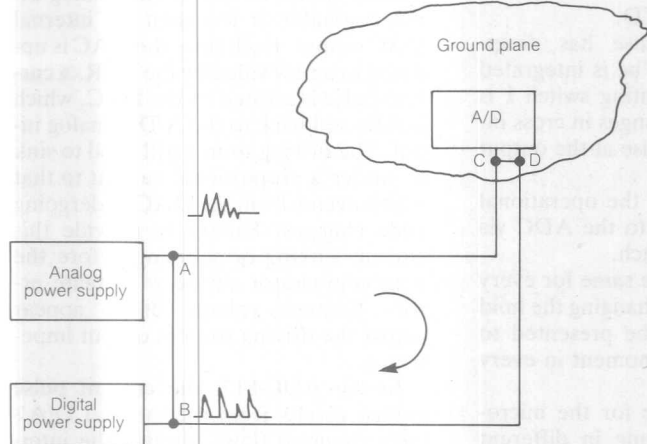


Figure 1. The ideal ground layout joins the analog and digital grounds at the ground plane beneath the converter (points C and D), not at the power supply (points A and B), and runs independent grounds to both supplies (A-C and B-D). One non-ideal ground layout joins grounds A and B with only one ground return (A-C) to the A/D, thus contaminating the analog ground return. The classic ground loop combines A and B, runs two returns to C and D, and also combines C and D.

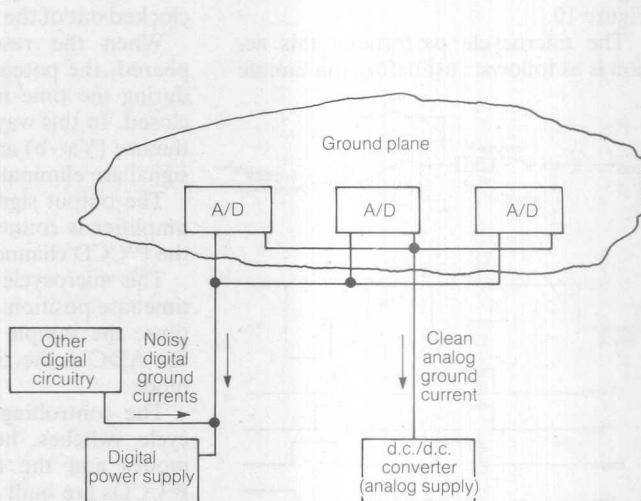


Figure 2. Impedance among converters can be minimised by the use of a large ground plane. A local, isolated analog power supply may be needed to clean up noise.

ADC-500 (Datel's 12-bit, 500 ns hybrid) gives a 0.01 % change in full scale range (FSR) for every 1 % change in the power supply voltage (0.01 % FSR/% VS). Linear power supplies designed for converter products usually keep the percentage change less than 0.1 % for variations in load. Thus the effect from a maximum change permissible in the power supply would be less than $1/20$ of an LSB of the ADC-500.

These specifications are, however, at d.c. and assume clean power supplies. A look at the power supply rejection versus frequency of some amplifiers inside the converters tells the real story. The 100 dB (16 bits of accuracy) power supply rejection at d.c. quickly degrades to -40 dB (6 bits of accuracy) at a frequency of 10 kHz.

Power lead inductance, combined with stray capacitance on high speed converter devices, can cause oscillations on the supply lines, affecting internal converter components. Obviously,

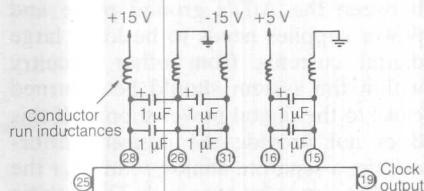


Figure 3. The use of decoupling capacitors ensures fast settling step response on the power supplies.

Improved P²CCD design facilitates digital storage operation

Integrate-and-hold

The output signal has to be adapted before it is presented to the ADC. This is performed by the integrate-and-hold circuits seen in the block diagram in Figure 6 and shown in more detail in Figure 10.

The microcycle performing this action is as follows: Just before the sample

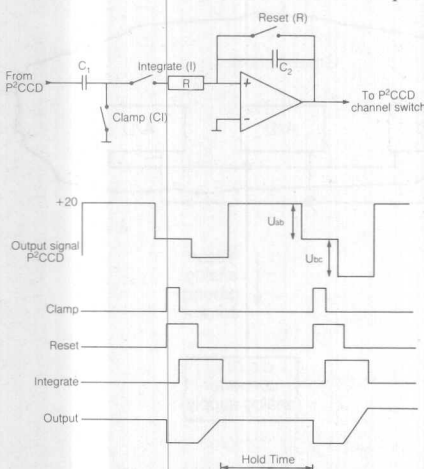


Figure 10. An integrate-and-hold circuit adapts the output signal from the P²CCD for presentation to the ADC.

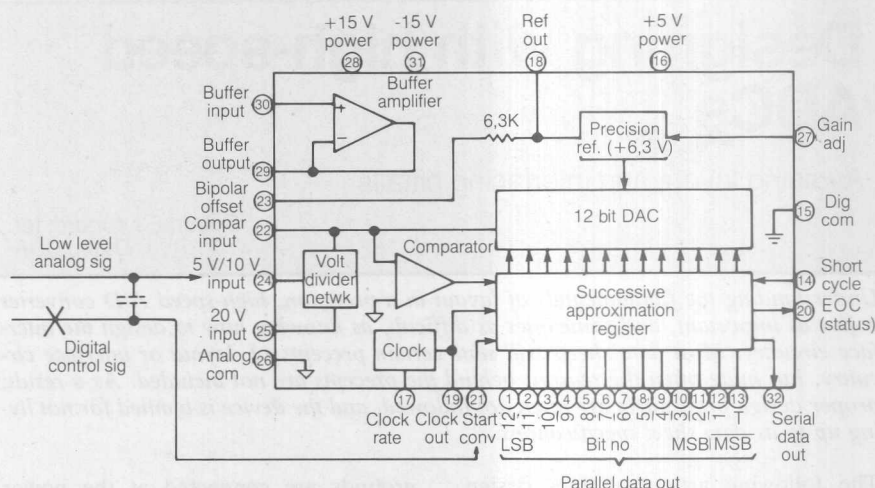


Figure 4. The successive approximation A/D (ADC-817 shown) should have digital control signals routed away from sensitive analog inputs.

these must be avoided or accuracy will suffer. Bypassing the power supplies directly at the A/D's pins with high frequency decoupling capacitors (0.01 µF ceramic) may still find the circuit ringing. The stray power lead inductance and the capacitance will represent an LC tank circuit whose response for a current step would be oscillation. Paralleling the high frequency decoupling capacitors with low frequency decoupling capacitors (1 µF to 10 µF tantalum) lowers the resonant frequency of the tank circuit (Figure 3). Should the Q of the circuit still not be low enough, the addi-

tion of a low value resistor (1 Ω) in series with either of the bypass capacitors will ensure fast settling step responses.

Input drive requirements

Careful attention must be paid to the input drive requirements of high-speed A/Ds to assure that they will meet their accuracy requirements. This is especially true for successive approximation types.

The heart of the successive approximation A/D is the internal DAC (Figure 4). The D/A's bits, from MSB to LSB, are successively turned on or off by the successive approximation register (SAR). Upon receiving an initial or an updated code, the D/A must then settle at the comparator input to the accuracy of the device within a time frame controlled by the system clock (e.g. about 150 ns for the 2 µs conversion time of Datel's 12-bit hybrid ADC-817).

When the comparator receives a strobe from the system clock, the comparator decides whether the analog input is greater or less than the internal DAC output. Each time the DAC is updated to a new value by the SAR, a current pulse is created by the DAC, which is reflected back to the A/D's analog input. The driving source will need to sink or source a proportional current to that which occurs from the DAC undergoing code changes. Failure to provide this current sinking or sourcing before the next comparator strobe will create errors because voltage drops appear across the driving sources output impedance.

In the ADC-817, the current pulse (which results from the internal D/A's code changes) flows through the internal inductance of the conductor runs and bond wires of the hybrid converter. This same current pulse then flows through the user's connections to his driving source. Short leads from the successive approximation A/D are imperative to minimise the resulting in-

Continued from page 15

is clocked out, capacitor C1 is charged at level Vb via clamping switch C1. At the same time capacitor C2 is reset. Once the clamp pulse has disappeared (clamping switch C1), integrating switch I is closed. After this the sample is clocked out of the P²CCD.

When the reset pulse has disappeared, the potential Vbc is integrated during the time integrating switch I is closed. In this way, changes in cross influence (Va-b) and noise at the output signal are eliminated.

The output signal of the operational amplifier is connected to the ADC via the P²CCD channel switch.

This microcycle is the same for every timebase position. By changing the hold time, the sample can be presented to the ADC at the right moment in every mode.

The controlling logic for the microcycle switches, hold time in different modes and the reset signals for the P²CCDs are built around two programmable array logic elements (PALS). Compared with conventional logic components this saves a lot of space and eases fault finding.

8707-014 on Service Card



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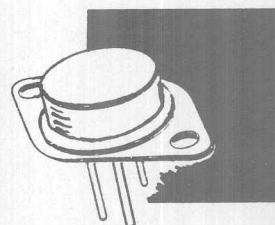
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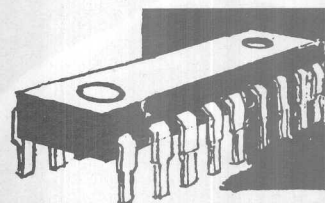
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APPLICATION NOTE: AN-446.



MF8CCN

4TH ORDER FILTER

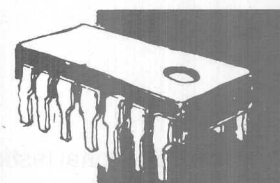
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DS14C89AN

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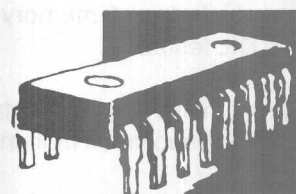
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INTERNAL INPUT THRESHOLD HYSTERESIS.
COMPANION DRIVER IS DS14C88N.
APPLICATION NOTE: AN-438.



DAC1218LCD-1

12-bit BINARY MULTIPLYING DAC

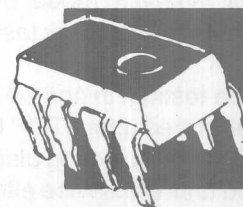
12-bit LINEARITY, ZERO & FULLSCALE ADJUST ONLY.
FULL 4-QUADRANT MULTIPLICATION.
12-bit RESOLUTION; GUARANTEED MONOTONICITY.
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NMC9346N

1K EEPROM

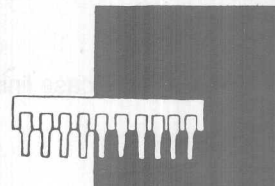
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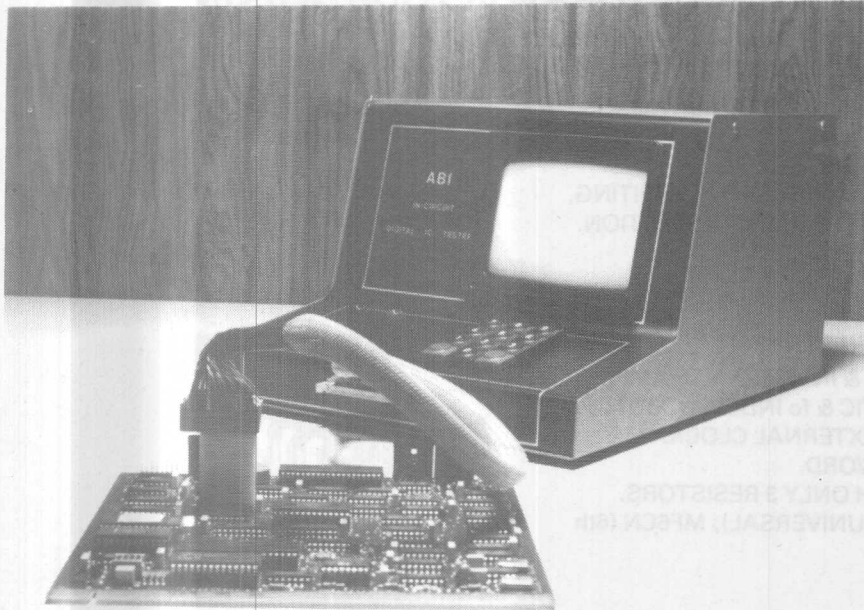
CAPE TOWN: P.O. BOX 1020 CAPE TOWN 8000 TELEPHONE 21-5350 TELEX 5-27320
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PULSE/SA MEASUREMENT & CONTROL - July, 1987 19

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Model No ABIC-1

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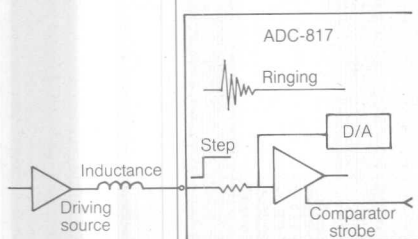


Figure 5. Inductance of external and internal conductor runs causes ringing which the driving source must settle before the clock strobes the comparator.

ductance of this connection. The D/A current step into the inductance causes ringing – which the driving source must be capable of settling to within the accuracy of the A/D at the signal bandwidth of interest (Figure 5). This settling has to occur before the next comparator strobe (e.g. 150 ns for the ADC-817). This requires the input source amplifier, whether a sample-hold or buffer amplifier, to settle within 150 ns (12 bits).

Thus, it is not enough only to ensure that the analog input has settled to the appropriate accuracy before beginning an A/D conversion. The drive source must be able to handle the current pulses from the internal D/A and subsequent ringing. Monolithic buffer amplifiers or sample-holds for successive approximation A/Ds may not meet these requirements, even for d.c. inputs, and hybrid driving sources may be required to meet the settling time requirements for the frequencies of interest.

Two-pass or sub-ranging A/Ds have less stringent requirements than successive approximation types. The ADC-500, for example, has its analog input first digitised by a 7-bit flash converter to determine the seven most significant bits. A feedback D/A with 13 bits of linearity subtracts this 7-bit result from the analog input, producing a residual voltage. This residual voltage is amplified and converted by a second pass of the flash converter. This result, along with the first pass, goes to an adder to determine the full 12-bits of the A/D (Figure 6). There are no current pulses from

each D/A bit because the D/A feedback occurs in one instance and goes to internal amplifiers of the A/D rather than the analog input. The choice of a buffer amplifier, or sample-hold for a two-pass device, can thus be focused only upon signal bandwidth considerations.

Separation of analog and digital signals

Precision A/Ds handle very low level signals – into the millivolt and microvolt range. Contamination of these analog signals can occur from charge injection caused by changing digital logic levels leaking through stray capacitance (Figure 4). Extreme care should be taken to route digital lines away from sensitive analog inputs, references, offset, and gain adjustment input pins. Shielding sensitive analog signals and the use of low impedance paths (ground planes) around sensitive analog input pins may be required to ensure trouble-free operation.

Dynamic linearity errors

The successive approximation A/D architecture has critical time constraints to accomplish internal functions to meet its accuracy specification. Inside, when the successive approximation register turns a D/A bit on, the D/A is allotted a certain time frame to settle at the comparator input. Upon receipt of the system clock strobe, the comparator decides what the equivalent logic level will be set for the A/D bit. A/D transfer errors, which result because of the D/A's unsettled state to the full accuracy before the comparator makes its decision, are often referred to as dynamic linearity errors.

Many high speed successive approximation A/D converters do not have output latches for the parallel output data and output latches are required, therefore, external to the converter. The unbuffered outputs of the A/D's SAR are also the internal D/A's digital inputs. When the D/A bit is turned on, there is an exponential rise time as the bit goes to a high logic level (Figure 7). Stray capacitance from long leads to output

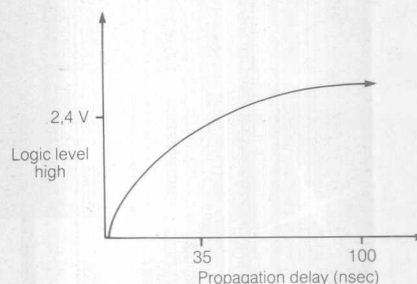


Figure 7. Stray capacitance increases rise time for a digital logic high level.

latches can prevent the D/A from turning on as quickly as is needed, thus reducing the D/A settling time. Upon receiving the clock strobe, the comparator will make a decision – whether or not the D/A has settled to the required accuracy. Therefore, the distance from the parallel output data to the output latches should be kept to less than 25 mm to prevent dynamic linearity errors (Figure 8).

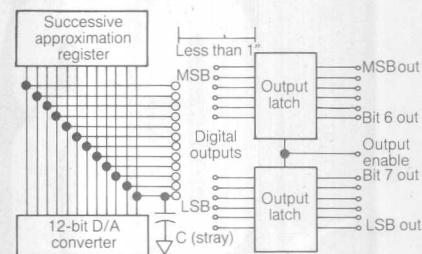


Figure 8. Parallel outputs of successive approximation A/Ds are the internal D/A's inputs. Keep these signal paths less than 25 mm in length.

The comparator input of the successive approximation A/D is normally brought to an external pin on the A/D. This allows offsetting for bipolar full scale ranges and adjustment of initial offset errors through the use of external trim pots. Note that the comparator input is also the internal D/A's output. Capacitance appearing on the D/A output can also prevent the D/A from settling to full accuracy within its allotted time frame. Stray capacitance must be minimised on this pin to assure proper settling. The offset adjustments wiper resistor should be located extremely close to the A/D to avoid stray capacitance on the comparator input.

Unipolar configurations do not require the bipolar offset pin to be tied to the comparator input. However, the nature of bipolar operation requires offsetting the comparator input by tying the bipolar offset pin to the comparator input. Most A/Ds locate the comparator input and bipolar offset pins next to each other so this connection can be kept very short. Also, some A/Ds are dedicated for either unipolar or bipolar configurations and, therefore, inherently prevent additional capacitance from being added when they are being used in a bipolar configuration.

Continued on page 24

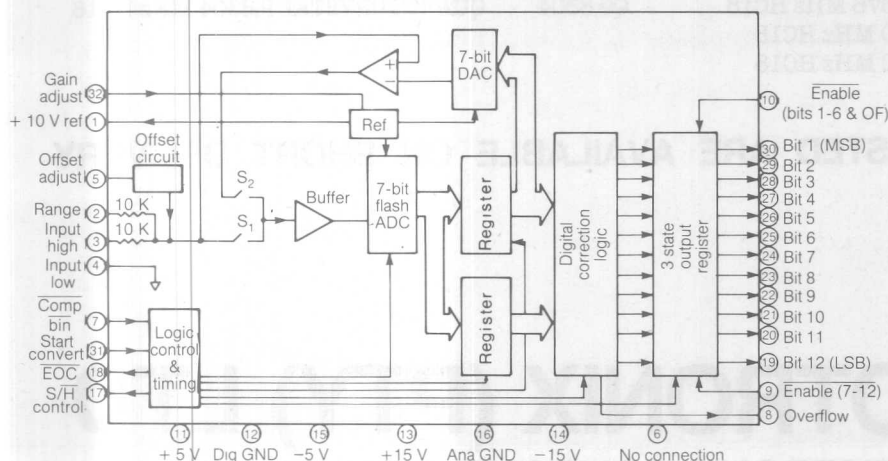
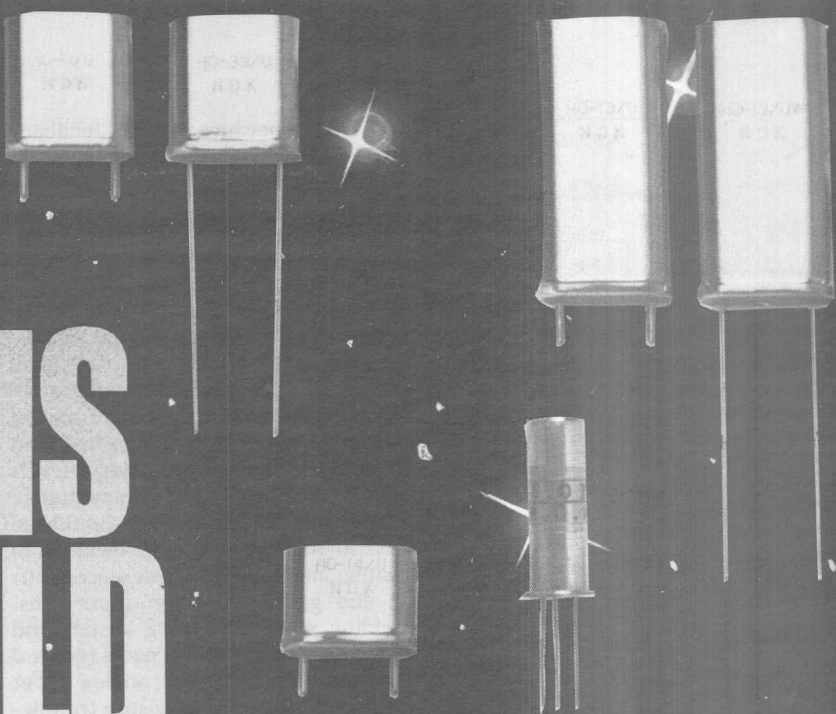


Figure 6. Block diagram of a two-pass or sub-ranging A/D (Datal ADC-500).

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Q1,8432	QUARTZ CRYSTAL 1,8432 MHz HC18	Q3,6864	QUARTZ CRYSTAL 3,6864 MHz HC18
Q10,0	QUARTZ CRYSTAL 10 MHz HC18	Q4,0	QUARTZ CRYSTAL 4 MHz HC18
Q11,0592	QUARTZ CRYSTAL 11,0592 MHz HC18	Q4,1943	QUARTZ CRYSTAL 4,1943 MHz HC18
Q12,0	QUARTZ CRYSTAL 12 MHz HC18	Q4,433619	QUARTZ CRYSTAL 4,433619 MHz
Q14,0365	QUARTZ CRYSTAL 14,0365 MHz HC18	Q4,9152	QUARTZ CRYSTAL 4,9152 MHz HC18
Q14,7456	QUARTZ CRYSTAL 14,7456 MHz HC18	Q5,0688	QUARTZ CRYSTAL 5,0688 MHz HC18
Q18,0	QUARTZ CRYSTAL 18 MHz HC18	Q6,0	QUARTZ CRYSTAL 6 MHz HC18
Q18,432	QUARTZ CRYSTAL 18,432 MHz HC18	Q6,144	QUARTZ CRYSTAL 6,144 MHz HC18
Q2,0	QUARTZ CRYSTAL 2,0 MHz HC18	Q7,3728	QUARTZ CRYSTAL 7,3728 MHz HC18
Q2,097152	QUARTZ CRYSTAL 2,097152 MHz HC18	Q8,0	QUARTZ CRYSTAL 8 MHz HC18
Q2,4576	QUARTZ CRYSTAL 2,4576 MHz HC18	Q9,8304	QUARTZ CRYSTAL 9,8304 MHz HC18
Q20,0	QUARTZ CRYSTAL 20,0 MHz HC18		
Q24,0	QUARTZ CRYSTAL 24,0 MHz HC18		

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Air particle technology

Megachips increase particle measurement and filtration requirements

Dr. H.H. Schicht
Luwa AG, W. Germany

The race currently under way between the American, Japanese and European micro-electronics industries to be first into production with the 1 M-bit and then the 4 M-bit memory is challenging the air filtration and clean room industry.

The objective is to establish the environmental conditions necessary for research, development, pilot manufacture and high-volume production of integrated circuits with finer and finer structures, with respect to the cleanliness, temperature and humidity of the air, so that product quality can be ensured and the reject rates reduced.

In Table 1, the critical particle diameter is given as a function of the storage density of the chip. As can be seen, the 16 and 64 k-bit chips did not create particular problems: laminar flow clean rooms achieving class 100 according to the US Federal Standard 209 b were adequate.

As storage density is increased, however, cleanliness requirements become more severe and are no longer covered even by the strictest quality requirements laid down in the recognised cleanliness standards both with respect to particle size and to particle concentration. For the production of 256 k-bit and 1 M-bit chips there must be no more than 350 particles $\geq 0,12 \mu\text{m}$ per cubic metre of air.

Cleanliness definitions

Revision of the official cleanliness stan-

dards has been initiated to bring them in line with present and future requirements. Until the availability of the new standards, no commonly accepted language base will exist. Thus, for the time being, individual guarantee values will have to be agreed between supplier and customer covering both the particle concentration as well as the corresponding particle size. Luwa suggest that cleanliness class definitions as given in Table 2 be adopted.

Particle measurement

The traditional instrument for measuring particle concentrations in clean rooms, both during performance testing and performance monitoring, is the optical particle counter. However, with its minimum detection limit of $0,3 \mu\text{m}$, a sampling rate of $28 \ell/\text{min}$, and a measuring range of six decades, it is no longer adequate for the validation of class 1 and class 10 clean rooms nor for monitoring production operations where critical particle sizes down to $0,05 \mu\text{m}$ are relevant.

The laser particle counter permits limited advances, pushing the minimum detectable particle size down to $0,1 \mu\text{m}$. On the other hand, due to the reduced

sampling flow rate of $3 \ell/\text{min}$ or less, sensitivity is limited and if statistically significant readings are to be obtained within a practical time scale, then a detection rate of 10 counts/min equal to 3,5 particles/ ℓ is seen as a limit. Therefore, without using special tricks, the practicability of this instrument is already nearly exhausted when a class 10 clean room is involved. Furthermore, at the actual state of the art, whereas a minimum detectable particle diameter of $0,1 \mu\text{m}$ may be marginally acceptable for the 1 M-bit chip, it is clearly insufficient for the 4 M-bit chip. Therefore, the laser particle counter has, at the present state of the art, practically no reserves for coping even with the requirements of an immediate future. Another limitation is the measuring range of only six decades.

An instrument long used in meteorology and atmosphere physics, but only recently considered for air filtration and clean room work, seems capable of overcoming these limitations: the condensation nucleus counter³. This instrument is characterised by a minimum detectable particle size of $0,01 - 0,02 \mu\text{m}$ and a measuring range of nine decades; moreover, it is available as a mature, robust industrial product suitable for field work. Whilst sampling rate is only $0,3 \ell/\text{min}$, due to the very low detection limit this is of reduced practical importance; at $0,02 \mu\text{m}$ particle size, a class 1 clean room would still give a particle count of 36 particles/ ℓ so that this instrument is suitable for the evaluation of filters and clean rooms at this quality level; albeit with certain limitations.

A flow diagram of the instrument is shown in Figure 1. Sampling is performed continually using the same procedures as in the case of the particle

Table 1. Line spacing and critical particle diameters for high density integrated circuits according to Edmark and Quackenbos¹

Storage density [k-bit]	Line spacing on wafer [μm]	Minimum critical particle [μm]	Market dominance period
16	4,0	0,4	1981-1984
64	2,5	0,3	1984-1988
256	1,5	0,17	1984-1988
1×10^3	0,9	0,09	1988-1990+
4×10^3	0,5	0,05	1988-1990+

Table 2. Luwa proposal for extrapolating the US Fed Std 209b²

Cleanliness class	Particles per litre equal to and greater than:			
	0,02 μm	0,1 μm	0,5 μm	5 μm
1 (new)	35	1	0,035 *	★★
10 (new)	350	10	0,35	★★
100	★★★	100	3,5	★★
1000	★★★	★★★	35	0,25
10 000	★★★	★★★	350	2,5
100 000	★★★	★★★	3500	25

* indication only meaningful for class definition purposes (see also ★★)

★★ indication not meaningful for measurements, due to statistical reasons

★★★ indication not relevant for the definition of cleanliness requirements.

Table 3. Technical data of the Luwa RR-R, RR-S and RR-T HEPA and ULPA filters

Product denomination	RR-R	RR-S	RR-T
Nominal face velocity	0,50	0,50	0,50
Nominal air flow rate per m ² face area	1800	1800	1800
Initial pressure drop at nominal face velocity	70	160	210
Quality classification as per DIN 24184	R	S	★
Flammability classification as per DIN 53438	K1/F1	K1/F1	K1/F1
Max continuous temperature °C	100	100/125	125
Initial separation efficiency			
Paraffin oil mist test ϕ 0,3-0,5 μm (DIN) 24184	98	99,997	★★
Sodium flame test (BIS 3928)	>95	99,995	★★
DOP test (US MIL-Std 282)	>95	99,99	★★
Test with condensation nucleus counter, $\phi \geq 0,02 \mu\text{m}$	—	99,99	99,9995

★ classification ruling not yet established

★★ test method not suitable because of insufficient measuring range of the prescribed particle counting method

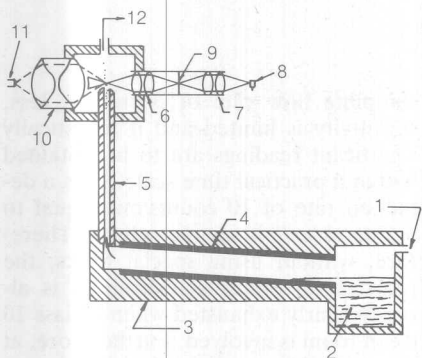


Figure 1. Schematic diagram of a condensation nucleus counter: (1) aerosol inlet; (2) alcohol pool; (3) saturator tube (kept at 35 °C); (4) Dacron felt; (5) condenser tube (kept at 10° C); (6) imaging lens; (7) condensing lens; (8) lamp; (9) slit (0,1 mm × 2 mm); (10) collecting lens; (11) photo detector; (12) to flowmeter and pump. (Courtesy TSI Inc, St. Paul, USA)

counter. Upon entering the instrument, the air stream is brought into contact with liquid alcohol. The alcohol evaporates until saturation with the air is more or less achieved. The sampling air stream is then cooled down so that the alcohol vapour becomes supersaturated. If particles are present in the air stream, the supersaturated alcohol condenses on their surface: equilibrium is established when the particle diameter has augmented to approximately 10 µm. After this particle enlargement stage, the sample enters the detector zone where particle counting is performed conventionally using forward scattered cold light. Because of the large particle size of 10 µm in the detection zone, the instrument has an extremely high signal to noise ratio.

Advances in air filter performance

For the cleanliness requirements of the class 1 clean room, the traditional HEPA filters (high efficiency particulate air filters) with the highest quality level (i.e. the S class filters according to

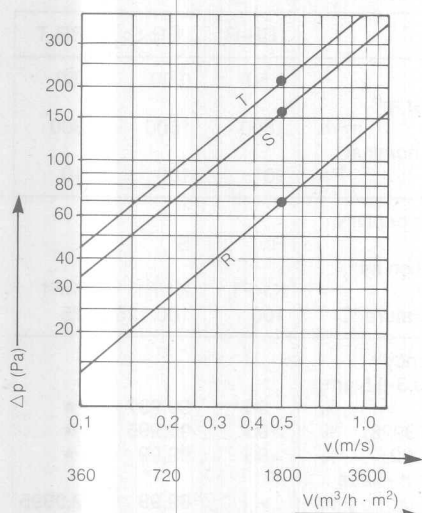


Figure 2. The initial pressure drop in function of the face velocity v (in m/s) and the specific air flow rate V in m³/h per m² of face area, for the Luwa RR-R, RR-S and RR-T HEPA and ULPA filters.

the DIN 24 184⁴ classification, having a minimum separation efficiency of 99,97 % for particles of 0,3 µm diameter) are no longer adequate. Since the cleanliness requirements for the clean rooms have become 100 times more exacting, filter performance had to follow suit. Table 3 shows, as an example, a comparison of the technical data of typical R- and S-class HEPA-filters with the new product generation, named the T-class filter in anticipation of a forthcoming amendment of the DIN standard mentioned above and called ULPA filter (ultra low penetration air filter) in the American literature. Figure 2 shows the initial pressure drop as a function of the face velocity and of the specific air flow rate.

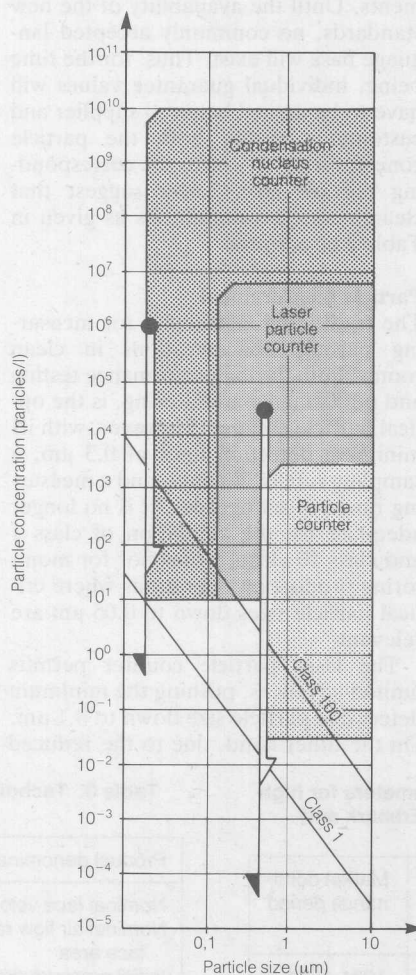


Figure 3. The filtration performance of the Luwa RR-S (white arrow) and RR-T filters (black arrow), for particles of 0,02 and 0,05 µm diameter respectively, taking the natural aerosol (dotted line) as point of departure. The shaded areas demonstrate the measuring range of three different types of particle counting instruments.

Figure 3 illustrates the performance of the S- and T-class filters in relation to the requirements of the cleanliness classes 1 and 100.

It can be clearly seen that the new T-class filter copes with the requirements of class 1 clean rooms. When exposed to a natural aerosol upstream of the filter with the characteristics as given in Figure 3, the cleanliness of the filtered air is of such a level that not only are the

class 1 requirements met, but that a sufficient margin is maintained to allow for the unavoidable particle dissemination during work in progress in the areas to be protected. This margin becomes even more pronounced when return air from a clean room installation is recirculated.

From Figure 3, it can also be seen that only the condensation nucleus counter has the sensitivity and the measuring range for correct and reproducible quantitative testing of the new T-class ULPA filters.

Summing up: at equal face velocity, the new T-class ULPA filter improves the separation efficiency by a factor of 100 in relation to a comparable S-class filter, with a pressure drop only about 30 % higher.

The new T-class ULPA filter described is manufactured according to the minipleat principle, the filter frame being built up from anodised aluminium profiles. □

Further information is available from Luwa (South Africa) (011) 804-1256.

This article was condensed from a paper presented at the *Integrated Circuit Plant Consortium Conference* held in Leicester.

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Designing with high speed ADCs

Continued from page 21

Avoid long conductor runs

Although the bipolar offset pin is located next to the comparator input (Figure 4), a short connection is not always possible. When wiring to external cards, use only low capacitance switches, short leads, and a large ground plane.

System layouts, which enable the end-user to pin-strap the A/D for unipolar or bipolar operation, often involve long conductor runs for ease of mode selection. These, however, make the comparator input susceptible to capacitance and noise pickup.

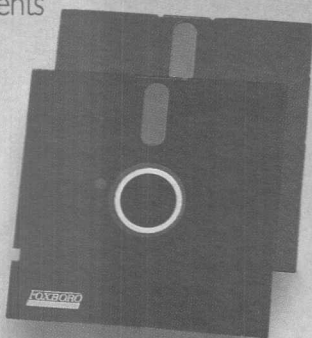
Two-pass architectures do not incur these dynamic linearity failures because of the nature of their operation. □

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This article first appeared in *I&CS - The Industrial and Process Control Magazine*, January 1987.

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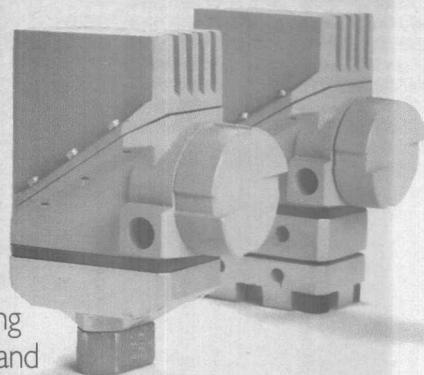
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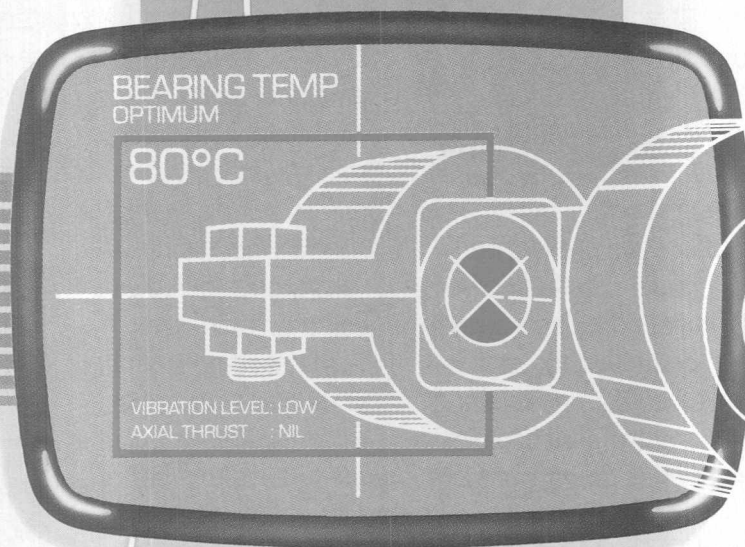


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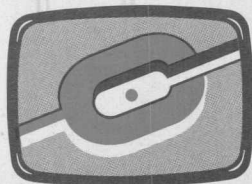


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Transducers for vibration monitoring

Selecting the correct transducer for monitoring rotating machinery

Mark Gilstrap
Bently Nevada Corp, USA

The monitoring of essential and general purpose machinery in addition to critical machines has been increasing steadily. Some of these machines have lower operating speeds and many use rolling element bearings. In selecting the appropriate transducer for monitoring these machines, fundamental considerations of shaft versus bearing housing measurements must be addressed.

This article will discuss the proper selection of housing or shaft measurement transducers for vibration monitoring, as opposed to analysis, of rotating machinery. The criteria for transducer selection and signal conditioning/readout instrumentation can be quite different for monitoring versus analysis, even on the same machine.

Machinery monitoring requires the use of a transducer which provides the most significant output signal change when the machine has a problem.

Meaningful Information

When choosing between shaft and housing measurement transducers, the machine problem and vibration characteristics can be restated: which vibration measurement, shaft or housing will provide more meaningful information concerning both the normal and malfunction conditions of the machine? Under normal conditions (usually low vibration), which part of the machine, the shaft or housing will produce the most significant vibration? The word 'significant' means meaningful or informative, concerning the object being measured, and implies using the transducer with the best signal-to-noise ratio.

When considering machine problems, the user must also answer: under malfunction conditions (usually, but not always, high vibration), which part of the machine, the shaft or housing will produce the most significant (usually largest) change in vibration?

The more frequently occurring malfunctions on most classes of machinery are rotor-related. That is, the problem (unbalance, misalignment, rubs, etc) either originates at, or is manifested by, a change in rotor (shaft) vibration. Vibrations which originate at the machine housing or casing are less common.

For most applications, therefore, it seems logical that a shaft vibration measurement would be preferred. However, in certain machine designs, some of the vibration originating at the shaft is transmitted to the bearing housing. Thus, the ultimate question is: for a

given machine, can rotor vibration be detected only by direct measurement of the shaft or does the bearing housing measurement faithfully represent rotor-transmitted vibration?

Whether a machine exhibits more vibration amplitude (and more meaningful vibration data) at the shaft or the housing is primarily determined by one or both of the following factors:

- the relative stiffness (or compliance) of the bearing and its support; and
- the mass ratio between the rotor and the stationary machine components (housing/casing).

In order to avoid writing a textbook on the mechanical design of rotating machinery, perhaps the concepts can be illustrated by the following examples (Figure 1).

Case One

Some machines with fluid film bearings have relatively rigid bearing supports and/or small rotor mass compared to the casing. For these machines, very little shaft motion is transmitted to the bearing housing. Thus, the optimum parameter to be measured is shaft motion relative to the bearing or bearing housing. This measurement is available from proximity probes mounted adjacent to the bearing (Figure 1 (a)). Machines in this class include centrifugal and axial compressors, blowers, and pumps as well as mechanical drive steam turbines, motors, and generators.

Case Two

A machine with fluid film bearings may exhibit small or no shaft relative motion. Virtually all, or most, of the shaft vibration energy is transmitted directly to the bearing and bearing housing, and, therefore, measurements should be made at this location (Figure 1 (b)).

Case Three

Some machines with fluid film bearings may exhibit both shaft relative and casing absolute vibration in significant amplitudes. In general, if one amplitude is at least 20 % of the other, then both should be considered significant. For this application, a dual probe (combina-

tion shaft relative proximity probe and bearing housing velocity measurement) should be used (Figure 1 (c)). The absolute velocity signal of the casing is integrated to displacement and 'added' (instantaneous time summation) to the relative displacement signal of the shaft to yield shaft absolute displacement.

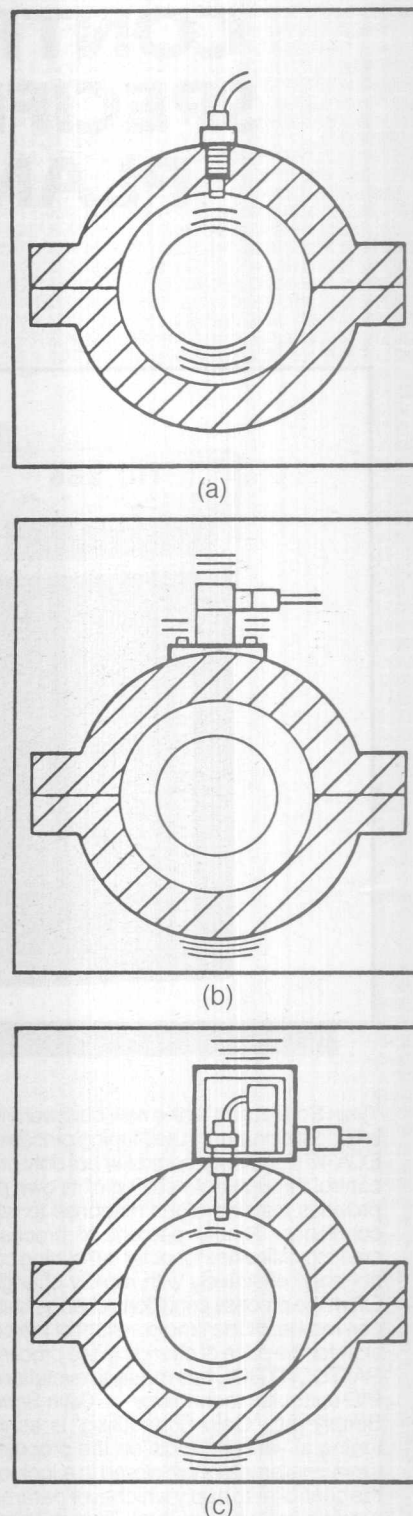
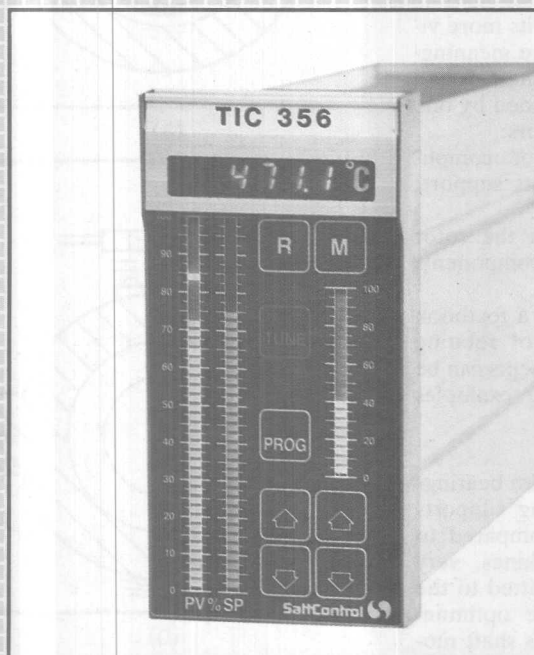


Figure 1. Three methods of measuring shaft vibration: (a) shaft vibration using a proximity probe; (b) bearing housing vibration using a seismic transducer (velocity or accelerometer); and (c) dual probe measures both shaft and bearing housing vibration.

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These machines typically include, but may not be limited to, medium and large steam turbogenerators (especially the low pressure cases), large gas turbines (especially the exhaust bearing sections), and some large fans.

The appropriate transducer is typically a velocity pickup, sometimes with its output signal integrated to displacement. Accelerometers can be used if the signal-to-noise ratio is satisfactory. Very low frequency measurements may be a problem here, however.

These machines have relatively compliant bearing supports and/or low case-to-rotor mass ratios. They include some large fans (massive rotating elements), machines with vertically-supported pillow block or pedestal bearings (compliant supports), and some gas turbine designs.

Case Four

Machines with rolling element bearings have almost no shaft motion relative to the bearing under normal operation because the bearing, by design, is effectively a zero clearance device. Granted, as a bearing begins to fail and clearances increase, shaft motion relative to the bearing will also increase. But this measurement provides little advance warning of the impending problem.

Most of the shaft vibration is transmitted to the bearing housing on these machines. Thus, the appropriate measurement is absolute vibration of the bearing housing. If a velocity transducer is used, a direct evaluation of velocity units will tend to emphasise the bearing-related vibration frequencies. Integration of the velocity signal to displacement is more representative of shaft-related vibrations. Ideally, velocity transducers are used in conjunction with a monitor which processes the transducer signal in two separate paths, one velocity and one displacement.

Accelerometers may be used as well, and the signal can also be integrated, but double integration to displacement becomes difficult, especially at low frequencies. On the other hand, an accelerometer may be the only viable option when the bearing frequencies of interest exceed the upper frequency limit of the velocity transducer (usually around 1 to 2 kHz).

An exception in this machine category is a rolling element bearing with a squeeze film damper. Here, proximity probes mounted to the outer bearing support will be more meaningful.

Finally, on machines with rolling element bearings, a new technique is evolving whereby the minute outer race displacement vibrations are measured through the special installation of proximity probes.

Case Five

The above cases relate to transducer selection for a monitoring system. Most monitoring systems are somewhat of a

compromise between economic considerations and providing a sufficient degree of protection against the majority of, but perhaps not all, potential machinery malfunctions. Therefore, a machine may require one type of transducer for continuous monitoring, but may require another type of transducer for analysis if an unusual malfunction occurs.

Comparing measurements

The best method with which to determine whether shaft or housing measurement is required is to take some actual measurements on the installed machine in the field. Three pieces of information are needed:

- ☐ shaft vibration relative to the housing;
- ☐ housing absolute vibration; and
- ☐ shaft absolute vibration (the instantaneous time summation of the above).

Measurement of shaft vibration relative to the housing can be obtained by using a fabricated bracket or temporary (but solid) mount for a proximity probe. Housing absolute vibration measurements can be made using a velocity transducer (output signal integrated to displacement). The velocity transducer may be handheld, but is preferably

mounted with a magnetic base, stud or bolted flange. The mounting location should be directly on the machine part supporting the proximity probe mount, at the same lateral location and angular orientation of the probe.

Measurement of shaft absolute vibration can be derived from the first two measurements using a differential summing amplifier or by visual observation and graphical resolution of the two timebase waveforms using an oscilloscope. Actually, if any two of the three measurements can be made, the third measurement can be derived from visual observations on the oscilloscope. It is sometimes difficult to temporarily and effectively install a proximity probe, especially on a running machine! On the other hand, it is usually easy to measure housing absolute vibration on a bearing housing.

Shaft absolute motion can also be measured with a velocity sensor mounted on a 'shaft stick' or 'fishtail.' However, in order for this measurement to be valid for comparison with the housing vibration and final derivation of the shaft vibration relative to the housing, the shaft area that is used to make the measurement must be close to the same lateral location as the housing-mounted sensor. Often, the avail-

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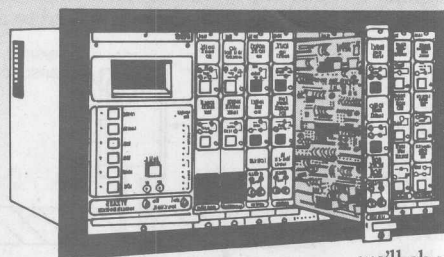
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able exposed shaft area is too far removed from the bearing journal to provide comparative information.

Bearing or free space measurements?

For machines equipped with fluid-film bearings, measurements of shaft motion as opposed to bearing housing or casing motion has generally proven preferable. Assuming that shaft motion measurement is desirable, the remaining question is: should the measurement be made relative to the bearing (housing) or relative to free space (shaft absolute)?

How is shaft motion measured?

At first glance, it would seem that the answer to this question could be obtained in a very straightforward manner. Simply make both measurements on a given machine and determine which data are more meaningful.

The desired information is knowledge of overall rotor behaviour. Therefore, if the majority of shaft motion energy is absorbed within the bearing clearance, and very little is transmitted to the bearing housing, then shaft relative measurement is required. On the other hand, if a significant amount of shaft vibration is transmitted to the bearing housing, then shaft relative measurement alone may not be satisfactory. Indeed, if virtually all the shaft motion is directly transferred to the bearing housing, then bearing housing measurements alone could be adequate. There are such cases with fluid-film bearing machinery. But in most situations, there is usually a significant level of shaft activity relative to the bearing, and that vibration may or may not be transmitted to some degree to the bearing housing.

Significant levels of motion

Even if the two measurements can be made on a given machine, what levels of motion should be considered 'significant'? At least one guideline is a publication by the International Organisation for Standardisation (ISO): 'Measurement and evaluation of mechanical vibration of non-reciprocating machines as measured on rotating shafts'.

Concerning evaluation criteria, the document suggests: 'When the relative motion transducer support structure vibration is 20 % or more of the relative shaft vibration, then the absolute shaft vibration will be measured, and if found to be larger than the relative shaft vibration, it will be used as the measure of shaft vibration'.

What if both measurements cannot be made readily and conveniently on a given machine? Suppose a user is purchasing a new machine, or retrofitting an existing one, and does not have prior knowledge of its vibration characteristics? At least two factors should be considered: the casing-to-rotor mass ratio and the compliance of the bearing sup-

port structure. Machines with high casing-to-shaft mass ratios generally have very little housing activity as a result of shaft vibration. Machines with compliant bearing supports will usually exhibit some housing vibration transmitted from the shaft.

Measurement information required

When selecting the method of measurement, another factor to consider is the level of information required. If the purpose of the transducer installation is overall machine monitoring (that is, information which will indicate when the machine is in trouble) the selection process deserves one level of consideration. If, on the other hand, the same transducer information is to be used for diagnosing problems in addition to machine monitoring, then the selection deserves a greater degree of consideration.

One type of measurement may be satisfactory for detecting general changes in mechanical condition, but may not provide a sufficient level of information to determine why the change occurred. For example, it may be determined that shaft absolute measurement is desirable for continuous monitoring on a given machine, but the nature of various malfunctions may require shaft relative measurement to perform the analysis. The opposite case exists as well.

Shaft rider versus dual probe

Assuming that a shaft absolute measurement is desirable for monitoring and/or analysis, the type of transducer used to make the measurement must be considered. Two types are in general use, the shaft rider (Figure 2) and the dual probe (Figure 1 (c)).

The shaft rider consists of a rod assembly which extends through the bearing housing and literally rides on the shaft via a spring-loaded mechanism. The top of the rod, outside the bearing housing, is directly attached to a seismic

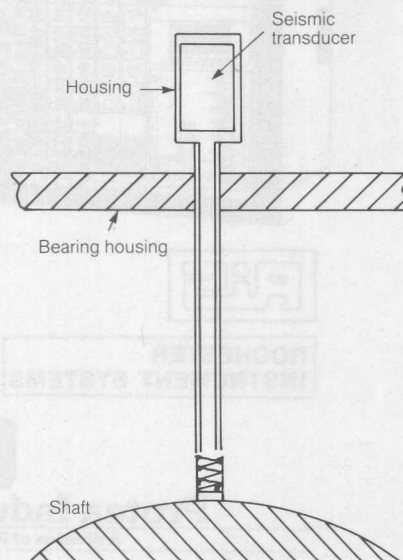


Figure 2. Basic layout of shaft rider.

transducer, usually a velocity pickup. The shaft rider measures shaft absolute vibration directly (and exclusively).

As shown earlier, a dual probe is the combination of a displacement proximity probe and a velocity seismoprobe installed together at a common reference point in which the velocity signal is integrated to displacement and then 'summed' to the shaft relative displacement signal.

The dual probe provides considerably more information about a machine's mechanical condition than does a shaft rider since the shaft rider provides a measurement of shaft absolute vibration only. The dual probe provides this same measurement plus measurements of shaft vibration relative to the bearing housing, bearing housing absolute vibration, and shaft relative position within the bearing clearance.

Consider the following statements made by a turbine manufacturer, on the comparison of dual probes and shaft riders:

'Proximity sensors do not contact the shaft surface but obtain a reading about 1.3 mm from the surface by transmitting and receiving a magnetic field and getting its measurements from the field intensity which is proportional to gap distance. There are no moving parts (except the seismic sensor for absolute measurement), providing excellent reliability and no wear. Accuracy and sensitivity are good up to 10 kHz frequency.'

'Shaft riders directly contact the shaft causing wear between shaft rider tip and the shaft. It must be located in a lubricated area, which usually means going through a bearing. The shaft rider is susceptible to 'oil whip' and has limited frequency response (good from 10 to 120 Hz). Due to moving parts and direct contact, sticking, slip, bounce, squeal, and chatter can occur, providing erroneous readings. Some of these factors make it difficult to calibrate a shaft rider system.'

In some installations, the available machine housing component for mounting the dual probe is not directly attached or referenced to the bearing itself. For these applications, the average radial shaft position information provided by the proximity probe may not be meaningful as a measurement of shaft position in the bearing. This information may also be affected by any steady-state movement of the proximity probe mounting e.g. a bearing housing which expands thermally relative to the shaft which, in effect, causes the probe to 'move away' from the shaft. In this application, it will also be difficult to maintain the original reference of the 'cold probe gap' for average radial position measurements. □

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Vibration measurement requires certain transducers for generating or transmitting signals to be processed and each application needs its own type of transducer to transmit a signal for vibration measurement.

Velocity pickup

The velocity, or seismic pickup (Figure 1) is generally used in the range from 480 to 120 000 r/min because frequency response is very linear within this range.

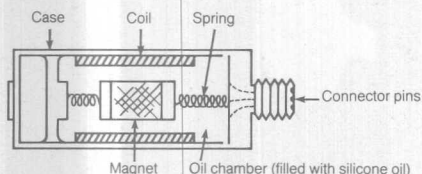


Figure 1. Basic construction of a velocity pickup.

A cylindrical coil is mounted to the case of a pickup and a permanent magnet is spring-suspended within the case. If the case of the pickup is placed against the vibrating body the case vibrates at the same magnitude as the body and the spring-suspended magnet remains stationary. In order to lower the natural frequency of the spring coil system a damping fluid (generally silicone oil) is put in the chamber.

Some of the benefits of velocity transducers are that they are self-generating, producing a voltage that is proportional to the actual vibration. They can also withstand a considerable degree of shock, are easy to install, and are best suited for anti-friction bearings, because of the minimal amount of damping of shaft vibration to the bearing housings.

Eddy current probe

In machines using sleeve bearings, oil tends to dampen the vibration between shaft and bearing, and an additional type of pickup, namely the eddy current or non-contact probe, is required (Figure 2)

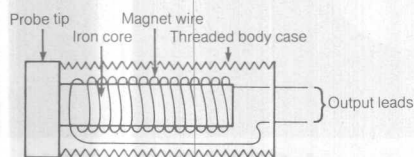


Figure 2. Basic construction of a non-contacting (eddy current) probe.

Magnet wire wound around a ferrous core creates a magnetic field and the probe is placed in proximity to a shaft, where the shaft to be measured completes the magnetic field. Typically, an

external electronic unit called an oscillator-demodulator conditions the high frequency signal. As the measured object vibrates, the resulting eddy currents modulate the signal from the oscillator which is then demodulated to produce an output signal proportional to the displacement of the measured shaft vibration. The non-contact probe stands off a certain distance, or gap, from the shaft, usually 1–1.5 mm. The output per probe is usually around 8 mV/μm.

Generally, since the geometric centre of a rotating shaft seldom follows a perfect circular orbit, a pair of sensors are needed to determine the true vibration level: one for horizontal movement and one for vertical movement. Most sleeve bearings have locking pins attached on either side of the bearing housing to prevent probe installation at the strictly

Figure 3.

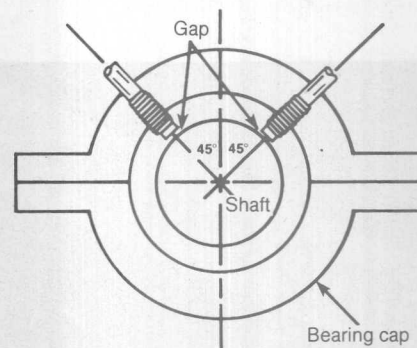


Figure 3. Installation of non-contact probes.

Accelerometer

Another type of transducer is the accelerometer (Figure 4) which is not self-generating and requires an input voltage.

A crystal cut to resonate at a specific frequency, is supported within a case. Mounted above the crystal is a mass. As

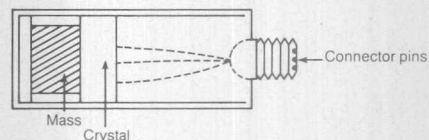


Figure 4. Basic construction of accelerometer.

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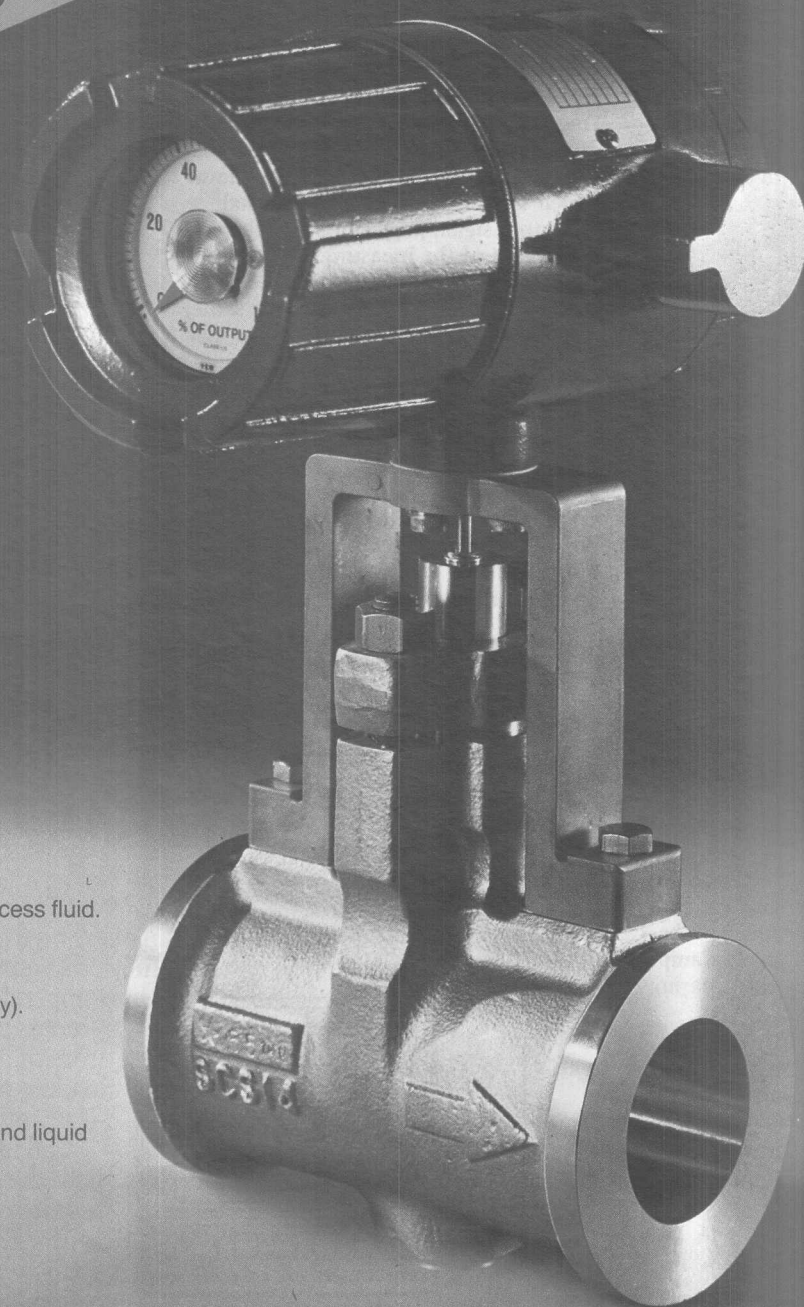
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the case of the pickup vibrates, the force of gravity acting on the mass attempts to deform the crystal. The crystal is a piezoelectric element, so it generates an electrical charge when a mechanical force is applied to it. Due to the exactness of the design of the accelerometer, it is more expensive than a velocity pickup.

Although an accelerometer does not measure velocity directly, an electronic integration can be performed on the output signal of the accelerometer to obtain velocity. Accelerometers generate high-frequency responses suitable for high-speed machinery and are very useful for monitoring vibrations in high temperature areas.

Installation

Transducer installation depends on the mechanical configuration of the assembly. Anti-friction bearings usually require contact pickups due to the low casing damping whilst journal bearings generally need non-contact pickups.

Generally, two velocity pickups, one mounted on the inboard bearing for radial vibration and one mounted on the outboard bearing in the axial direction, are adequate for determining misalignment and axial thrust. The inboard bearing usually consists of two non-contact probes mounted as shown in Figure 3 which also shows the preferred installation for equipment requiring non-contact probes for a typical sleeve bearing housing. Two probes are required, one for readings in the horizontal direction, and one for readings in the vertical direction.

Panel readout

Panel readout depends on the type of application and transducer selected for a particular piece of equipment. Axial movement must be measured in either a positive or negative direction. The readout on an analog output, therefore, will usually be labelled ± 1 mm. The units are always displacement since the concern is with the actual distance displaced rather than the speed at which the displacement is occurring. Axial movements are generally considered thrust movement and either positive or negative thrust exists in an axial direction.

Instrument racks house separate modules for each parameter measured. Axial motion is measured using a thrust module. Dual thrust modules for duplicate monitoring of shaft position in critical applications are available where excessive axial motion could cause severe damage. On a dual channel unit each channel has a separate meter for readout of axial position. There are usually four setpoints common to both channels, two for axial motion in one direction and two for axial motion in the other direction.

Actual shaft and bearing vibrations

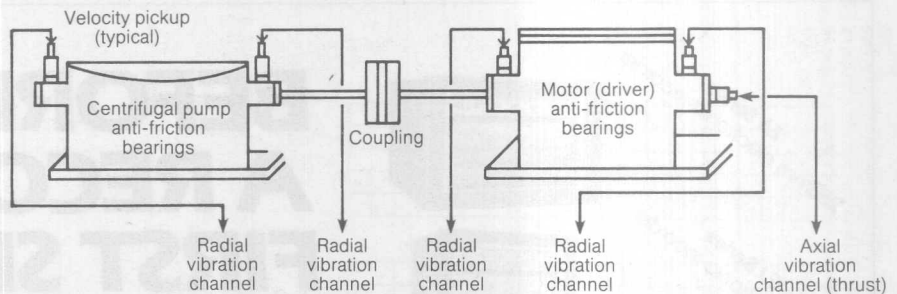


Figure 5. System design on a typical motor and centrifugal pump with anti-friction bearings.

are measured with radial vibration readout modules. A radial module can consist of a single channel for one point monitoring, or a dual channel for two point monitoring. The horizontal plane, (X plane), or the vertical, (Y plane), can be monitored using a dual radial vibration module.

Figure 5 illustrates an example of a system for monitoring an 1800 r/min motor that has been coupled to a centrifugal pump having anti-friction bearings. Velocity (contact) pickups may be used because of the anti-friction bearings. Notice, the motor has a contact pickup mounted for an axial readout and two contact pickups – one for inboard bearings, and one for outboard bearings with a radial vibration readout. These transducers will be read using a dual X – Y radial module. The units will be in velocity, mm/s (peak). The velocity measurement rather than dis-

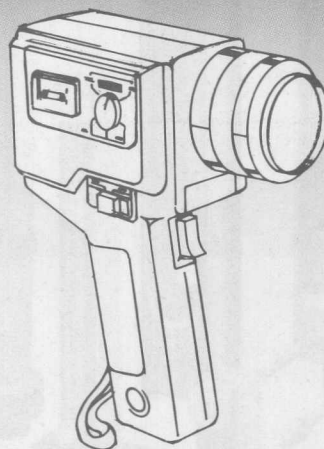
placement provides protection over a wide range of speed and frequencies. Thus, five inputs, namely four radial and one axial will be required.

In this example, four radial vibration channels and one axial vibration channel thrust module is needed. The instrument rack that will house these modules must be large enough to accommodate the modules. Each radial vibration module will take up one position in a component rack and the axial single-channel module will take up another. Therefore, the instrument rack must be large enough to house the five positions noted above, as well as the power supply and common control module if required. Since instrument manufacturers make different modules, the design of the system will vary in size.

(To be continued)

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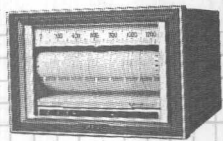
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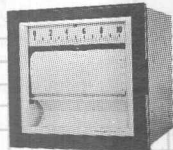
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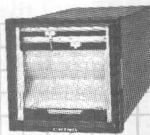
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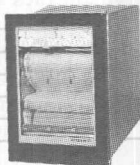
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Evaluating a data acquisition system

Part 2. Bandwidth requirements

Information from
NEFF Instruments Corp, USA

With sampled data systems, the question which always surfaces is 'How fast must I sample?' The question is valid since information is lost as a consequence of representing a continuum with a finite set of discrete samples. Thus, an immediate concern is with the number of samples it takes to reconstruct a reasonably accurate facsimile of the continuous input using this finite set of samples.

Accordingly, one of the specifications most often touted by manufacturers is analog-to-digital converter (ADC) conversion rates with the implication that faster is better. Unfortunately, there is another aspect of sampling which is often neglected but which must be addressed in order to establish the required sampling rate.

If the concern is not with graphically reconstructing the input from the samples but is, instead, with some other type of analysis, such as frequency analysis or even with establishing a steady-state value representative of the time averaged input, must the user be concerned here also with the number of samples and sampling rate? Since there is not a unique relationship between sampled data and the time varying continuous input, improper sampling can produce distortion referred to as aliasing. Thus, the user must be concerned with sampling even if the intent is to simply establish a single value, representative of the averaged input.

Sampling rate

Figure 1 illustrates, in the frequency domain, the relationship between input and output signals for a sampled system where the sampling frequency (f_s) was chosen to be twice the cutoff frequency (f_c^*), which is that input frequency beyond which there is no detectable or measurable energy. As shown, the sampler output consists of an infinite number of sidelobes with no overlap and thus no distortion.

According to the Nyquist sampling theorem, a signal that is ideally band-limited can be constructed from impulse samples if the sampling rate is at least twice the highest (or cutoff) frequency. With regard to data system specifications, the key words here are band-limited and impulse sampling. From this, it can be seen that in order to answer the question of how fast to sample, the frequency beyond which no measurable energy exists, must be known, that is, f_c^* .

Using this, the minimum sampling

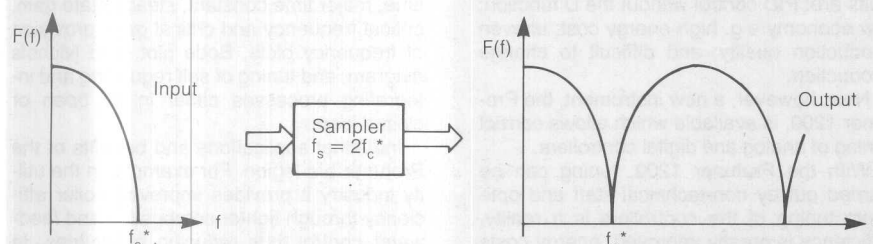


Figure 1. Relationship between input and output signals for a sampled data system.

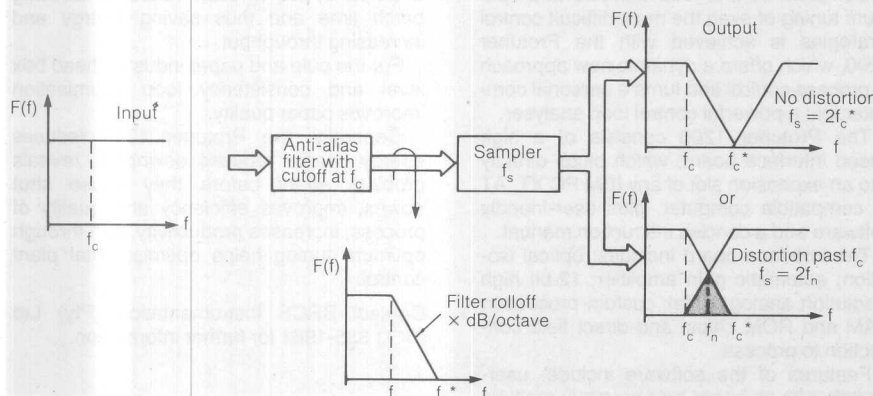


Figure 2. Relationship between desired bandwidth, anti-alias filter, and sampling rate.

rate f_s can be computed as:

$$f_s \geq 2 f_c^*$$

Anti-alias filter

There are three options available in choosing sampling rate. First, the user can simply ignore this relationship and sample at whatever frequency is desired. The consequences are that the sampled data may contain significant distortion error which can not be eliminated and which can even occur at zero frequency.

Secondly, the user can determine the cutoff frequency f_c^* by analysing each input with a spectrum analyser and choosing f_s accordingly. The implied assumption with this method is that the observed spectrum will not change over the course of the test period.

Thirdly, the user can establish f_c^* by inserting an anti-alias filter prior to the sampler. With this technique, the filter's cutoff frequency is selected based on the desired band of frequencies to be passed. Knowing the filter's well-defined attenuation characteristics, the frequency beyond which all energy is diminished to an acceptable level can be calculated and used to establish the required sampling frequency. Of these, the third option is the most conservative since it allows the user to quantify the maximum distortion in the bandwidth of interest.

The relationship which exists between the desired bandwidth, anti-alias filter attenuation characteristics, and sampling rate is illustrated in Figure 2. As shown, the input signal to the filter is assumed to consist of equal amplitude energy at frequencies which extend beyond the highest frequency of interest denoted as f_c . With the filter's cutoff frequency set at f_c , all frequencies beyond f_c are diminished in amplitude. The frequency beyond which there is no measurable (detectable) energy is denoted as f_c^* . If the ADC is a 12-bit (excluding sign converter) with full scale input of ± 10 V, then the minimum voltage which can be detected is:

$$\text{Resolution} = 10 \text{ V} / 2^{12} = 0.0024 \text{ V}$$

The converter's dynamic range is thus:

$$\text{Dynamic range} = 20 \log \frac{0.0024 \text{ V}}{10 \text{ V}} = -72.2 \text{ dB}$$

For this application, -72.2 dB is the required attenuation. For the chosen filter, with attenuation specified in terms of dB/octave, f_c^* can be computed as:

$$f_c^* = f_c \log^{-1} [N \log (2)]$$

where:

N is the number of octaves and is given by $N = \text{required attenuation} / \text{filter rolloff attenuation}$.

There are two choices in selecting the sampling frequency f_s . If no distortion (sidelobe overlapping) is required, then f_s can be selected as $2f_c^*$. However, since there is no concern about distor-

Table 1. Effects of filtering on required sampling rate

Filter	Attenuation	N	f_c^*	$f_s^{(2)}$	f_n	$f_s^{(3)}$
1-pole	6 dB/octave	12	4096	8192	64	128
2-pole	12 dB/octave	6	64	128	8	16
6-pole	36 dB/octave	2	4	8	2	4

NOTES:

(1) $f_c = 1$ Hz, 0 dB = 10 V, required attenuation = -72 dB.

(2) Minimum f_s for no sidelobe overlap.

(3) Minimum f_s for no distortion in passband only.

tion above the desired bandwidth, denoted f_c , a sampling rate can be selected which will permit overlapping of sidelobes beyond f_c . To compute this sampling frequency, the folding frequency f_n is established as:

$$f_n = \log^{-1} [0.5 (\log f_c + \log f_c^*)]$$

sampling frequency, f_s , is then computed as:

$$f_s = 2 f_n.$$

Table 1 summarises these different results for three different filters: 1-pole, 2-pole, and 6-pole. Here, the desired bandwidth (f_c) is 1 and each of the three filters has the cutoff frequency set at 1 Hz. For simplicity, it is assumed that the filter introduces no distortion in the passband. It should be noted that this is a worst case since the input is assumed to have equal amplitude at all frequencies.

Aperture time

A finite time is required by the ADC to convert from analog to a discrete value. If the ADC utilises the integration technique, then conversion time is chosen to be a multiple of the power line period. If the ADC utilises the successive approximation technique, then a finite time is required to make the various comparisons required. Regardless of which technique is used, a finite time is required. If the input is changing during the conversion time interval, then an error will be introduced. To reduce this error, ADCs often incorporate a sample-and-hold circuit which functions to capture and hold an instantaneous measure of the analog signal for the ADC. For low bandwidth applications, the error introduced by aperture time is generally considered insignificant.

The classic technique for approximating amplitude error resulting from aperture time is based on the point-slope technique (Figure 3). If t_0 denotes the

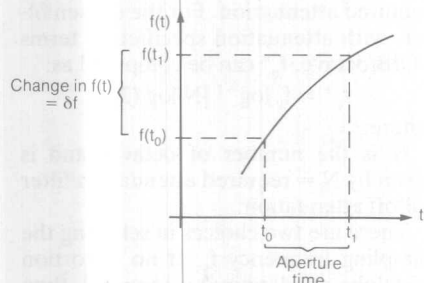


Figure 3. Error in input function resulting from aperture time.

beginning of the digitisation which continues until time t_1 , the input function will change by an amount equal to $f(t_0) - f(t_1)$. This can be approximated as:

$$\delta f = (df(t)/dt) \Delta T$$

where:

ΔT is aperture time.

If the input is assumed to be of the form:

$$f(t) = f^0 + A \sin(\omega t)$$

where:

f^0 is a constant; and

ω is angular frequency defined as $\omega = 2\pi f$,

then the time derivative is:

$$df(t)/dt = A \omega \cos(\omega t)$$

Since $|\cos(\omega t)| \leq 1$, the maximum value of the derivative is $A\omega$.

thus:

$$|\delta f| \leq A\omega \Delta T$$

This equation can be used to estimate the error (δf) resulting from a fixed aperture time ΔT for an input signal of frequency ω and amplitude A . Conversely, the equation can be used to establish a specification for aperture time based on a maximum error δf .

Channel-to-channel correlation

If channel-to-channel correlation is critical, then it may be necessary to incorporate a sample and hold circuit for each channel, depending upon sampling frequency and bandwidth. However, for low bandwidth applications, this is generally not a requirement.

Summary

There are no simple answers to the question of 'How fast must I sample?' As stated, improper sampling can produce distortion even at zero frequency. Furthermore, once sampled, there are no techniques to eliminate these errors. Accordingly, the answer to how fast to sample depends upon the desired bandwidth, the anti-alias filter's characteristics, and the amount of acceptable distortion in the passband.

(To be continued)

NEFF Instrument Corp is represented in SA by Hurbarn Electronics.

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Tuner for analog and digital controllers

Even skilled specialist technicians who normally spend many hours tuning controllers by a trial and error method, do not generally achieve 100 % successful tuning. Typical results are: PID control without the D function; low economy e.g. high energy cost; uneven production quality; and difficult to change production.

Now, however, a new instrument, the Protuner 1200, is available which allows correct tuning of analog and digital controllers.

With the Protuner 1200, tuning can be carried out by non-technical staff and optimum tuning of the controllers is a reality. Efficiency is greatly improved; energy costs cut; and a lot of money is saved with the resultant improved process economy.

Complete control loop analysis and optimum tuning of even the most difficult control strategies is achieved with the Protuner 1200, which offers a dynamic new approach to process control and turns a personal computer into a powerful control loop analyser.

The Protuner 1200 consists of a high speed interface board, which plugs directly into an expansion slot of any IBM PC XT, AT or compatible computer, plus user-friendly software and a concise instruction manual.

The interface board includes: optical isolation; automatic gain amplifier; 12-bit high resolution analog/digital; custom processor; RAM and ROM chips; and direct field connection to process.

Features of the software include: user-friendly with on board held screens; realtime display of process under test; calculation of

optimum tuning for three responses - minimum overshoot, 20 % overshoot, and quarter amplitude decay for P, PI or PID control; provision of loop parameters such as dead time, major time constant, steady state gain, critical frequency and critical gain; provision of frequency plots, Bode plot, and Nichols diagram; and tuning of self regulating and integrating processes either in an open or closed loop.

Industrial applications and benefits of the Protuner are legion. For example, in the utility industry it provides improved boiler efficiency through tighter combustion and feed-water control thus reducing boiler trips. In the petrochemical industry the protuner optimises the tuning parameters for both ramp and hold cycles on batch reactors, reducing batch time and thus saving energy and increasing throughput.

For the pulp and paper industry, head box level and consistency loop optimisation improves paper quality.

Generally, the Protuner 1200 reduces energy usage, reduces downtime, reveals problem areas before they cause shut downs, improves efficiency and quality of process, increases productivity, and through optimum tuning helps optimise total plant control.

Contact BRCS Instrumentation (Pty) Ltd (011) 835-1961 for further information.

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The TEAC XR Series, which uses VHS format videocassettes, offers a particularly high level of performance and operability. It uses 1/2 inch tape, for the same quality as open reel tape, but with the added ease of handling that only comes with cassettes. This series is equipped with an auto program loading function that lets you set the recorder up with a single touch, and five auto functions have automated a number of other settings. The XR Series is a recorder for advanced applications – but cassettes are inexpensive and readily available.

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The age of cybernetics/cybernation

New PLC achieves breakthrough in price/performance

Richard Francis
Yelland Engineering (Pty) Ltd

In Japan today, the new catch phrase in control engineering is 'cybernation'. Omron interprets this as the successful integration of computing, control and communications systems comprised of ultra-reliable hardware/software components to form an efficient network, leading to the ideal situation of the fully automated factory of the future.

In other words, the Japanese premise is: 'To the machine, the work of the machine, to man, the thrill of further creation.'

Mindful of South Africa's dismally low productivity (a contributory factor of labour to the high inflation rate), Yelland Engineering has teamed up with various suppliers and manufacturers in a joint effort to solve problems in South African industry, such as:

☐ computer integrated manufacturing (CIM);

☐ process control and material handling, utilising programmable controllers;

☐ electrical reticulation and motor control systems (specialising in both high and medium voltage electrical engineering);

☐ plant and factory automation;

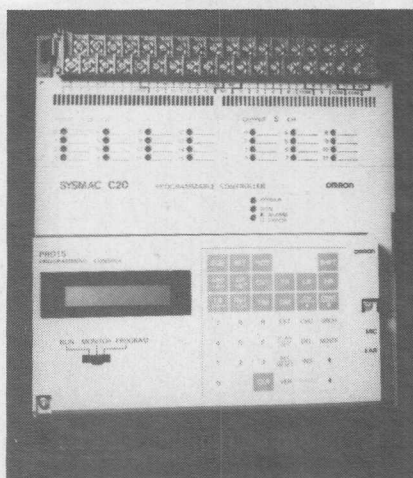
☐ distributed computer control systems including programmable controllers linked to host computers;

☐ the management of information and databases through plant supervisory control and data acquisition systems (SCADA colour-graphics based software packages); and

☐ engineering for safety in the plant by means of modular design 'building blocks', to provide flexible software components that are testable, adaptable to changes in the plant, reliable in operation, and that support programmable controller systems. (STARS program).

The aim is to drastically improve utilisation of resources, productivity and cut costs. For example, Yelland recently conducted a 'brainstorm' session with a large established South African company, drawing upon such resources as UWtec (the Sandton Science Park arm of the University of the Witwatersrand) and Hewlett-Packard Corporation, on the matter of flexible manufacturing systems.

A 'blitz' feasibility study, even when viewed qualitatively without detailed quantitative analysis, can show that further cost savings including: energy management, increased plant efficiency, and reliability are still possible, even in established profitable companies.



The new Sysmac C20 PLC from Omron.

The key to successful implementation is to adopt 'information' as the basis on which to design plants, and structure the analysis with a top down systems approach to cover all areas of design, operation and financing problems. The critical areas will be more readily identified, and long before grandiose schemes of plant optimisation and 'artificial intelligent/expert' systems are embarked

upon, the critical areas can be tackled first with small standalone programmable controllers. Later, individual systems can be linked together, using for example, the historical data base/trends gathered over time via a modest PLC SCADA system. This is easily implemented with the low cost/high performance Omron Sysmac C-series range of programmable controllers, and an IBM PC/AT compatible host computer link.

In fact large numbers of the Sysmac C20 programmable controller are being sold to first-time users for standalone applications (e.g. replacement of relay logic) requiring ultra simplicity and reliability in both programming and operation in the industrial environment, but retaining full accessibility to the very large PLC machines and peripherals forming a common family, unlikely to suffer the plague of modern hi-tech electronics – premature obsolescence due to rapidly changing technology.

The Sysmac C20 PLC is a common building block with powerful standalone features, and yet can be linked to expansion units, other PLCs and a host computer, over remote sites, using fibre-optic cable.

Other features include the range of off-the-shelf graphics packages to link the Omron PLC network (control, supervisory, monitoring, data-logging and report generation in realtime systems). However, one of the most important characteristics is that the Sysmac C20 PLC is the ideal programmable controller for the newcomer to get 'up to speed' with ladder diagram logic programming, and make the transition to larger machines with both standalone and networking features – quickly and reliably. ☐

For further information contact: Yelland Engineering (Pty) Ltd.

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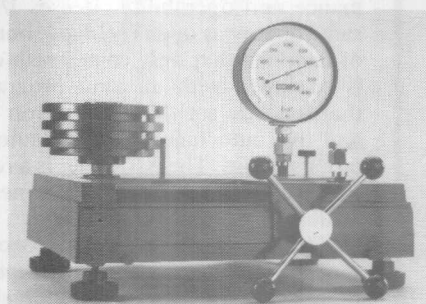
A guaranteed accuracy of 0,03 % is achieved by the Lucas Barnet range of deadweight testers now available locally from Negretti & Zambra.

The 5000 series are air operated instruments with single or double pistons with pressure ranges of 10 kPa to 3,5 MPa pressure, or –100 kPa to 3,5 MPa in the combined pressure/vacuum model. A supply line pressure indicator is supplied as standard.

The oil operated 8000 series also has single or double piston model types but has a much wider pressure range from 10 kPa to 110 MPa.

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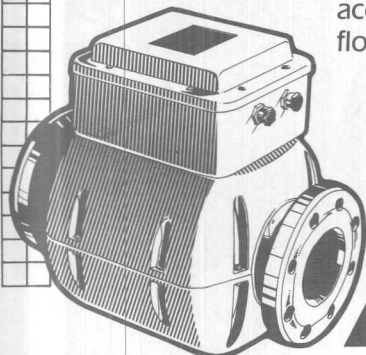
A full selection of accurate test gauges with accuracies of $\pm 0,25\%$ is also available in this range.

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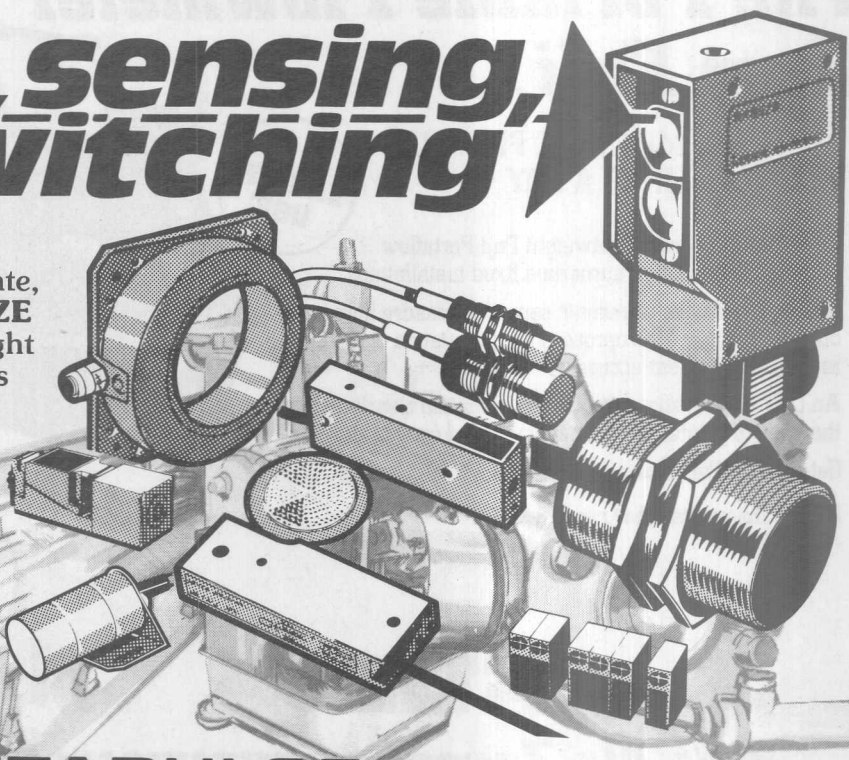
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Raymond Perkel Adv. and Design

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Improving hydrostatic head measurements

Improved mass accountability, interface control, and density compensation using ST 3000

Stan Whitman
Honeywell Applications Consultant, USA

The ST 3000, launched by Honeywell in 1983, was the first 'Smart' electronic transmitter on the market. Since its release constant research and application testing has yielded some interesting results, one of which is the transmitter's capability for improving hydrostatic head measurements.

Although the hydrostatic head principle has been a proven method of level measurement for many years, the installed precision using conventional pressure transmitters is insufficient for large storage tanks, decanters and coalescers. As a result, float systems are in wide use for level indication in large storage tanks, and have become the accepted standard by the American Petroleum Institute. More exotic devices such as conductivity and sonic probes have become popular for the liquid interface indications needed in decanters and coalescers. These devices are generally more difficult to maintain, more expensive, not always repeatable, and relatively unreliable.

The improved measurement precision available with the ST 3000 allows the implementation of hydrostatic head principles for mass accountability in

large storage tanks with at least twice the accuracy that can be achieved with currently used methods, and the control of interface positions for immiscible liquids with specific gravity differences down to 0,001.

In addition to the benefits derived from better measurement precision, other ST 3000 features eliminate the difficulties associated with elevated and suppressed zero calibrations encountered so often with tank level applications.

Mass accountability

Current methods of mass accountability include level measurement with a float device, density correction based on tank temperature, and density correction based on samples. Float devices can potentially provide the most precise liquid level measurement possible if properly

maintained. Unfortunately, this is not always practical. Accumulation of scale inside the float chamber, crimping or warping of the associated chain and tape mechanism, and material absorption into and out of the float itself can cause numerous difficulties as well as inaccuracies.

Density gradients across the tank are caused by ambient temperature changes or the addition of fresh material. For example, a 10° C temperature gradient from the tank wall to the centre can cause a 0,9 % density difference for many organic materials. Unless a tank is well mixed, samples that are obtained from near the tank wall also misrepresent the bulk contents.

The use of hydrostatic head principles for mass accountability can eliminate errors associated with the density determination because a more accurate representation of average bulk density inside the tank is provided. In addition, level and density measurement with electronic pressure transmitters offer a highly reliable alternative without the maintenance problems associated with float systems.

Absolute pressure units are recommended if the tank pressure is ever expected to operate under even the slightest vacuum.

The relative accuracies of mass accountability for large storage tanks are compared in Table 1. The comparison for hydrostatic head principles is made using both conventional and 'Smart' pressure transmitters. Although the specifications for level measurements using float mechanisms are superior, the combined precision of mass calculations with density determinations is substantially better with hydrostatic head principles when 'Smart' transmitters are used.

The value of this difference in precision is presented as the amount that cannot be accurately accounted for in the example presented by Figure 1.

For example, mass measurement for a 1,5 million kg inventory is accurate within \$11 000 using the hydrostatic head principle and smart transmitters rather than \$18 000 using a float system

Table 1. % uncertainties of mass calculations for storage tanks

Method	Level	Density	Combined	Kg error per million kg of inventory
Float and temperature	0,1	0,90	0,90	9000
Hydrostatic				
Conventional	0,90	0,74	1,0	10 000
ST 3000	0,48	0,38	0,56	5600

NOTES:

1-Level is for 25 m H₂O span.

2-Uncertainties include effect of multiple measurements.

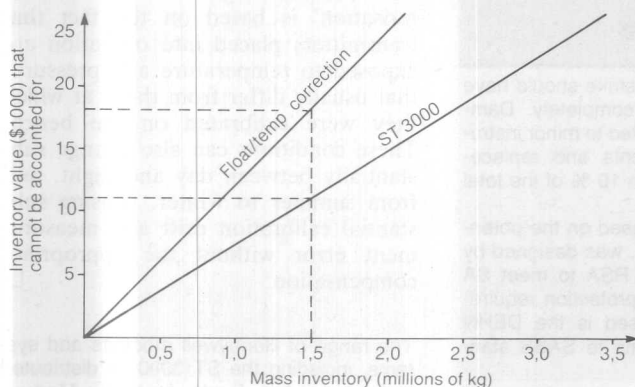


Figure 1. Impact of uncertainty on mass accountability.

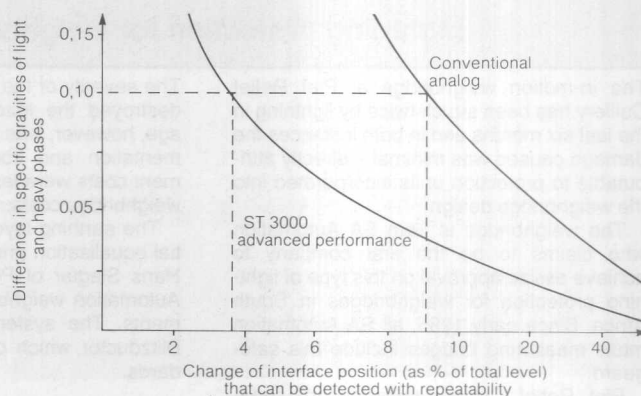


Figure 2. Improvement in interface control.

and temperature-corrected density. The inventory value unaccounted for is therefore reduced by almost a factor of two.

Interface control

Decanters and coalescers allow immiscible liquids of different densities to separate, usually by gravity, for subsequent processing. There are generally two liquid draw points and the boundaries between the liquid phases are known as interfaces. Reversal of the phase positions or movement of the interface to the top or bottom of the vessel can result in lost product, increased operating costs, and potential safety hazards.

The interface position of two-phase systems is commonly controlled at about 50 % of the distance between the upper and lower draw nozzles. Although hydrostatic head methods with conventional analog transmitters are used for many of these systems, control of the interface position of immiscible liquids with less than a 0.1 difference in specific gravities, has seen little success due to transmitter calibration drift and measurement inaccuracies. As a result, devices based on sonic, conductivity and radar technologies are commonly implemented for such systems. Unfortunately, all of these devices have limited applicability and are adversely affected by solids or bubbles at the interface. In addition, these devices generally provide single-point indications, sometimes requiring installation of clusters or a series arrangement, which complicates the implementation of automatic control strategies. Therefore, if not for the precision limitation of conventional pressure transmitters, the use of hydrostatic head principles would be preferable for greater reliability and an interface indication that is continuous for the entire vessel elevation.

The improved interface indications using ST 3000 'Smart' pressure transmitters is illustrated in Figure 2. Interface positions can be monitored with greater resolution and smaller changes in position can be detected with better accuracy. For example, the interface posi-

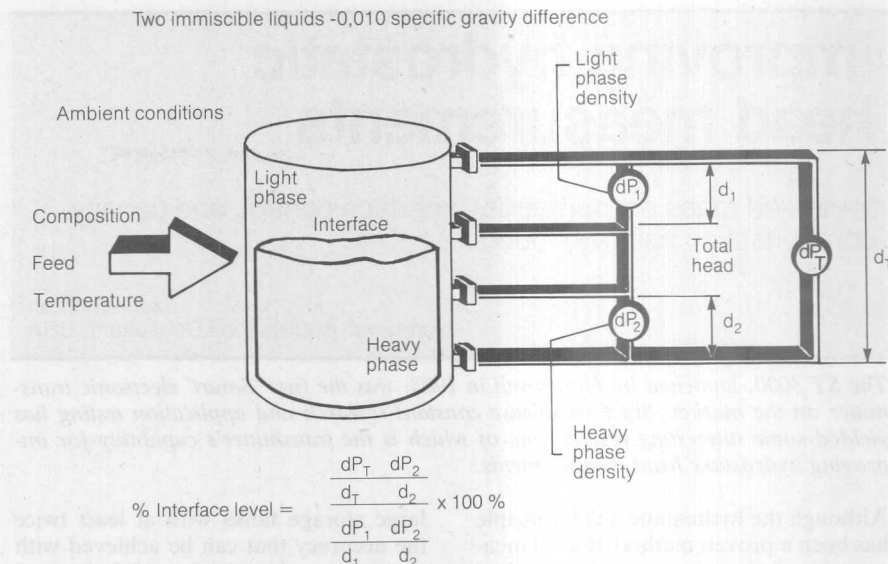


Figure 3. Automatic density compensation.

tion for liquids with only a 0.10 specific gravity difference can be controlled within a 3.5 % rather than the 9 % level change using conventional analog transmitters. Hence, the use of hydrostatic head methods to control interface position can now be considered for many decanters and coalescers that would have previously required the use of other technologies mentioned above.

Density compensation

The fact that there are very few decanters and coalescers that operate without variation in specific gravities is another consideration. The need to assume constant specific gravities to calibrate pressure transmitters for hydrostatic head applications presents a common problem. These assumptions cause substantial errors for liquids with small differences in specific gravity. With the improved precision of 'Smart' transmitters, it is now possible to continuously measure more successfully each of the phase densities, with a relatively small elevation distance between nozzle connections, so that the measurement of interface position can be automatically compensated for, as changes in phase

densities occur. A diagram of this concept is provided in Figure 3.

Characterisation

The improved precision of ST 3000 transmitters is achieved with microprocessor electronics and a process referred to as 'characterisation'. Microprocessors allow amplifier gain to be automatically adjusted as the signal changes to maximise the signal-to-noise ratio, unlike conventional electronic circuitry in which amplifiers and the range of gain adjustments are for the most popular portion of the operating range at the sacrifice of the signal-to-noise with turn-down.

The 'characterisation' process involves: response testing with known standards inside an environmental chamber over the device's entire range of operational specifications; development of a unique mathematical algorithm for every unit; and storage of the algorithm in PROM memory unaffected by dynamic operation of the unit.

The algorithm subsequently compensates the transmitter output signal for the effects of the temperature and pressure on the sensor at the actual installation. The significance of 'characterisation' is based on the fact that transmitters placed into operation are exposed to temperature and pressures that usually differ from those at which they were calibrated on the bench. These conditions can also change substantially between day and night, and from summer to winter, causing substantial calibration drift and measurement error without the appropriate compensation. □

The range of Honeywell products and systems, including the ST 3000, is distributed and serviced in South Africa by Martech Controls.

Lightning protection for weighbridge

The in-motion weighbridge at Piet Retief Colliery has been struck twice by lightning in the last six months and in both instances the damage caused was minimal – directly attributable to protection units incorporated into the weighbridge design.

The weighbridge is from SA Automation who claims to be the first company to achieve assize approval on this type of lightning protection for weighbridges in South Africa. Since early 1985, all SA Automation mass measuring bridges include this safeguard.

Piet Retief Colliery experienced, separately, a mains strike and a weighbridge hit.

The severity of the latter strike should have destroyed the loadcells completely. Damage, however, was restricted to minor instrumentation and components and replacement costs were less than 10 % of the total weighbridge costs.

The earthing layout (based on the potential equalisation principle), was designed by Hans Slagter of Pontins RSA to meet SA Automation weighbridge protection requirements. The system utilised is the DEHN Blitzductor which conforms to SABS standards.

Further information from SA Automation.

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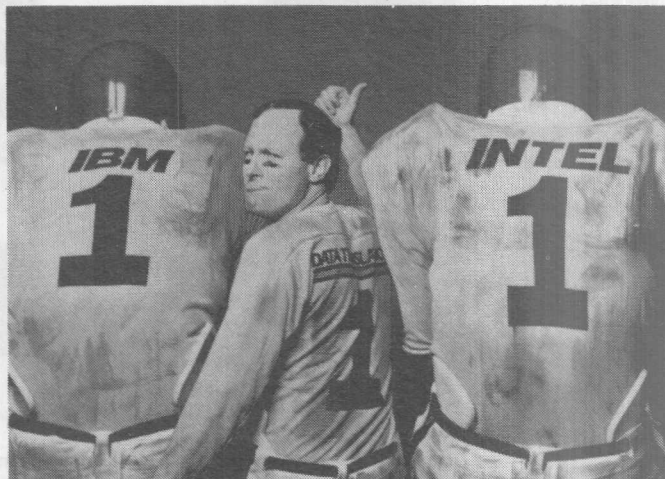
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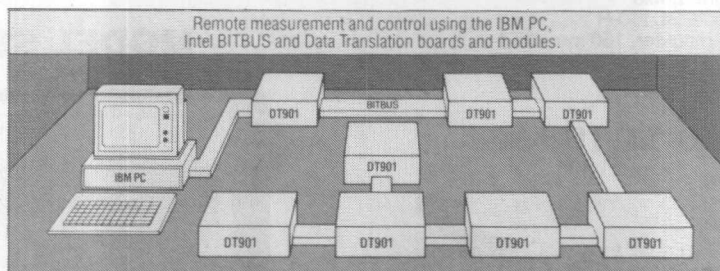
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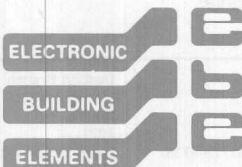
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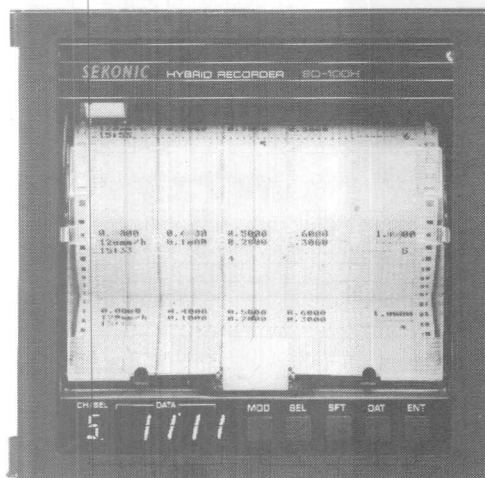
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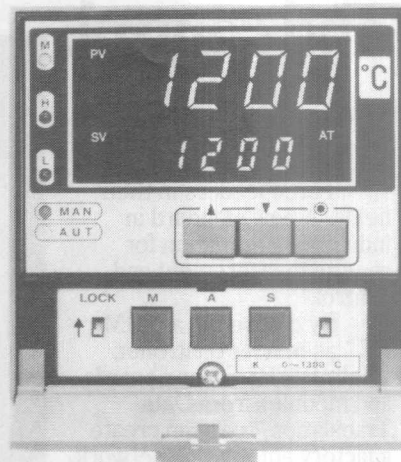


SEKONIC MODEL SD100-H HYBRID RECORDER



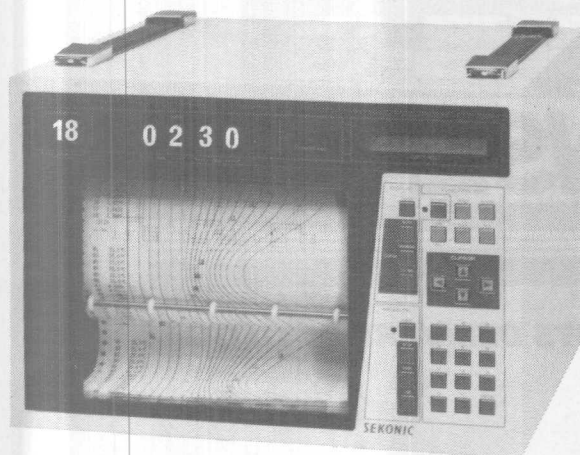
- 6 channel recorder
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digital print-out
analog/digital combination
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- H/L alarms on each channel
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- Also available: model SD150-H
18 channel hybrid recorder, 150 mm chart

SIGMA MODEL MDC10 MICROPROCESSOR CONTROLLER



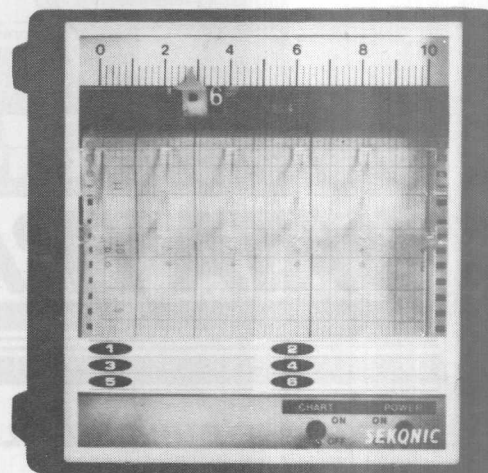
- Auto tuning
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Power line filters/surge suppressors

Pitfalls for the unwary

H. Slagter
Pontins RSA

Many devices are available, called power line filters/surge suppressors, ranging in price from a few Rands to several hundred Rands. All will claim to 'Protect your electronic equipment from spikes', but the reality, from even the claimed performance figures, let alone actual performance, may be very different.

Spikes of interference on the mains may be caused by many things including nearby switching or even lightning storms many kilometres away. The IEEE-587 curves shown in Figure 1 indicate that, in Europe, a piece of equipment connected to the normal electrical supply will suffer, on average, more than 1000 events a year above 1000 V.

Different modes

The highest energy level in electrical supply spikes is in the 20 – 30 kHz frequency region and interference is transmitted down electrical supply lines in two modes, often termed normal mode and common mode.

Equipment is vulnerable to interference in both the modes of transmission

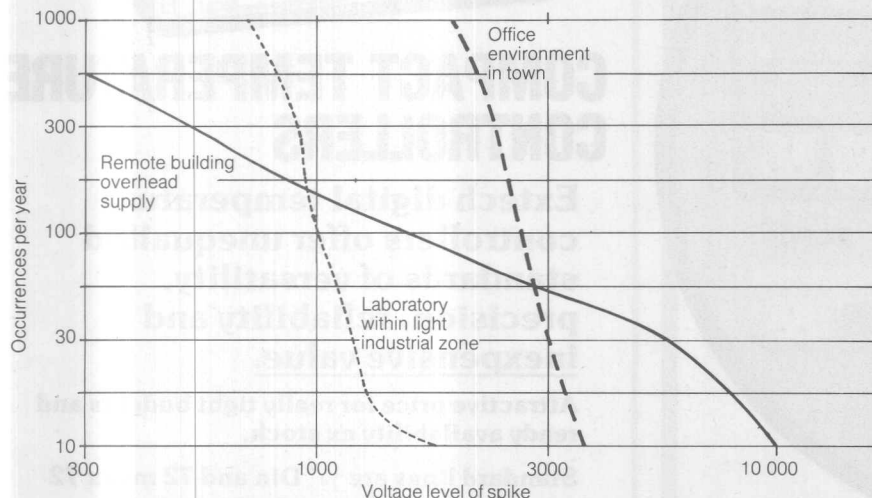


Figure 1. Typical levels of mainsborne interference in various environments.

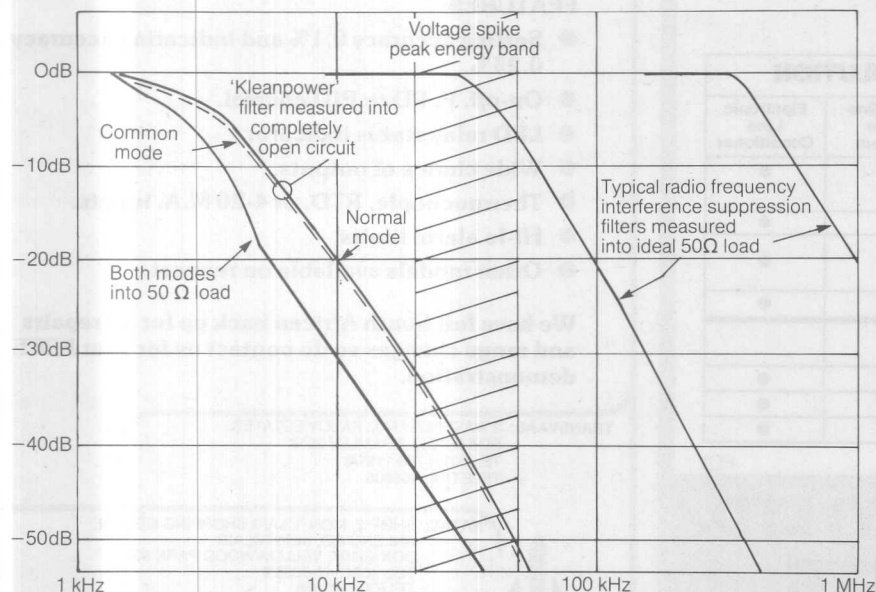


Figure 2. Comparative performance of lightning elimination filters relative to 'spike' spectrum and RFI filters.

although sometimes it is more sensitive to common mode interference than normal mode.

For a filter to eliminate damage and data errors in equipment it must, therefore, not only provide damage protection in both normal and common modes, but also provide substantial attenuation (some 30 times) at 20 kHz in both the normal and common modes, for data error elimination. Obviously the filter must continue to provide effective interference suppression no matter what load it is connected to.

Many filters on the market only provide surge suppression in the normal mode, and interference attenuation in the common mode. In addition, the simple, cheap-to-make filter circuit, often used, relies on normal mode interference being turned into common mode which only happens to a degree if the interference source is far enough away from the sensitive load.

Such units are usually specified as giving some 30 times, or more, suppression. However, this is only true above 100 kHz and then only on sinusoidal signals into a 50 Ω termination. And whilst they are correct to international specifications and effective for what is termed 'radio frequency interference suppression' at low amplitude levels, they are of little value for protecting computer-based equipment against data errors from mains interference.

Such devices are ineffective against mains interference which is:

- ☐ impulsive (spiky) in form causing normal filters to 'ring', thus giving output levels that may be higher than the incoming interference;
- ☐ peaking in energy at 20 – 30 kHz;
- ☐ generated from both nearby and distant sources giving normal and common mode interference; and
- ☐ going into equipment which presents loads that will be far from an ideal 50 Ω resistance.

Solution

The filters in both the Mains Box series and the Executive Power Distribution series from Pontins RSA provide:

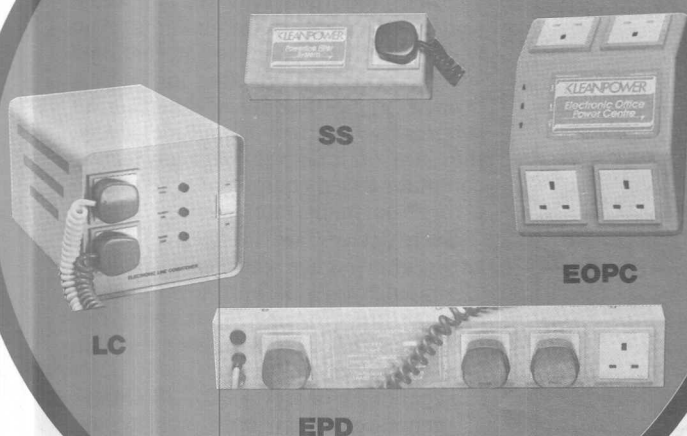
- ☐ protection against surges of up to 10 kA in common mode and 6 kA normal mode;
- ☐ filtration in both normal and common mode with a minimum suppression of 30 times at 20 kHz in both modes;
- ☐ filters which have been designed, and whose performance is specified, into a complete open circuit thus ensuring that no matter what load is connected the claimed performance levels will always be met if not exceeded;
- ☐ filters designed on the basis that interference is impulsive and which therefore give a minimal 'ring' on spikes; and
- ☐ multiple stage filtering with differing coil cores, ensuring that no matter how big the surge the filters will still be effective.

Continued on page 50



Get rid of interference with an Electronic Office Power System

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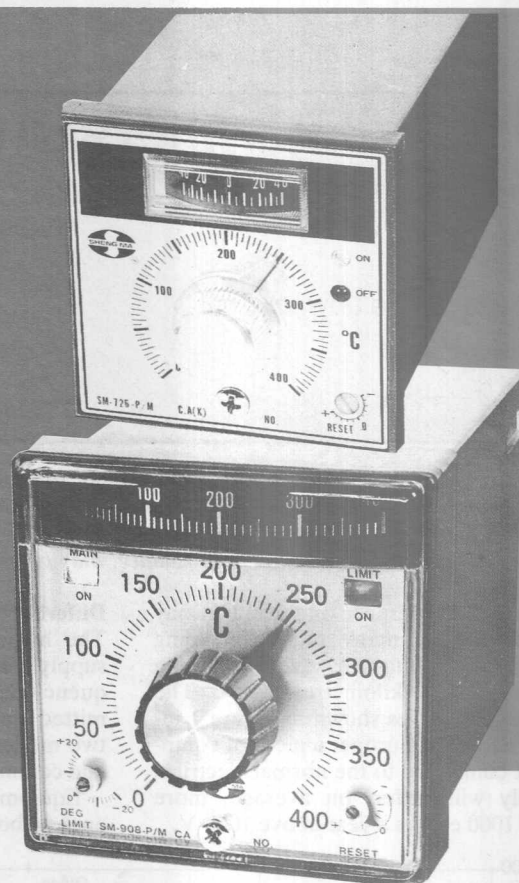
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Modern data loggers

Today's data loggers do more and are faster

Roger Ladwig
Acurex Corp, USA

During the past few years there have been several significant changes in data loggers (DLs) – both technologically and functionally. Most of these changes have not been made to improve the data logging function, but rather to move data loggers into few functions. Some of these changes are in response to pressure from other products, such as programmable logic controllers, process computers, and personal computers, since they add data acquisition functions to their basic capabilities.

Thus, the DL of today is a far cry from one of only five years ago. In fact the standalone DL has become a more viable product because of these changes and, in some cases, can be used as an entire measurement and control system.

This article reviews the six major areas of change in the data logger market:

- ☐ functional;
- ☐ data storage;
- ☐ A/D conversion;
- ☐ communications;
- ☐ intelligence; and
- ☐ use of PC software.

Functional changes

One of the biggest functional changes has been the addition of control capability which can be simple on/off contact control, straightforward analog output control, or even PID loop control.

Adding control functions to a DL is not that difficult because all the relevant process information is already collected inside the box. It is only necessary to add the desired control algorithms and provide an appropriate output device to act upon the control signal.

Another functional change has to do with data presentation. In addition to the conventional, narrow paper tape output, on-board CRTs are now available that simplify and improve process monitoring. Printouts in full format (216 × 280 mm) and user selectable layouts provide easier to read process reports (Figure 1).

Technological advances in printers



Figure 1. The Autograph 800 data recording system offers advanced graphics capabilities including: trending, logarithmic graphing, bar charts, histograms, scatter plots, and data logs.

have provided DLs with graphics capabilities allowing raw data to be now presented in visually understandable forms, such as trend lines, bar charts, histograms (statistical distribution), frequency distributions, X-Y plots, X-Bar R plots, and so on. Functionally, this makes a DL more of an on-line process information system.

DLs have also become data concentrators so that, in addition to collecting a mass of raw data, they can reduce it mathematically and store it until collection by a host computer. This frees the host from such tasks as data measurement, data conversion, and data reduction.

DL data collection speeds have also been increased. In fact, although it can be expensive, collection speeds of 500 kHz are now possible. This allows greater throughput because channels can be read faster. Whereas it may have taken up to 30 s to read 1000 channels before, it can now be done in less than 10 s, which means that larger data acquisition applications can be handled by a single DL.

Data storage

Several years ago, mass data storage meant large, bulky, reel-to-reel tape units. While tape still seems to be the most dominant method of data storage for the standalone data market, it is generally used in digital cartridge form. More and more, though, disc storage and solid state memories are being used as alternatives to tape.

Disc storage is being used in DLs by many manufacturers because of its random access and output flexibility. But discs are not perfect; dirt, grime, and vibration, which are common elements in industrial applications, can impair their ability to collect and output data.

The most popular type of solid state memory initially used was dynamic RAM. Its benefits, though, of fast access and retrieval flexibility, were offset by its volatile nature which requires sophisticated battery backup schemes and power refresh circuits to prevent memory loss during a power failure.

The use of CMOS static RAM, has

significantly reduced this power loss backup problem. Because CMOS RAM draws less power than dynamic RAM, battery backup techniques can hold the memory for significantly longer periods of time, and in some cases, up to sixty days. Typical on-board DL storage capacity provided by solid state memories varies from as few as 60 to more than 100 000 readings.

Another data storage technique coming into use is bubble memory which has the advantages of both disc and static RAM storage, but not their limitations. Access time is very fast and, with proper care of the bubble memory packs, data storage is virtually permanent. In addition, because there are no mechanical parts, very little maintenance is required. Currently, however, bubble memory is expensive and it remains to be seen if DL manufacturers can use it cost-effectively.

DL memory has also been improved from the standpoint of how the scan programs are being stored. Electrically erasable programmable read only memories (EEPROM) are now being used which provide the permanence of a programmable read only memory (PROM) and the programmability of a RAM. Programs can be created and stored without the need of battery backup. Thus, should there be a catastrophic failure of the device, the program can be instantly reloaded from the EEPROM. In addition, programs created on one DL can be saved in EEPROM and then loaded into other DLs. And, while EEPROM is still fairly expensive, its price is expected to fall significantly during the next several years.

Analog to digital conversion

Basic A/D conversion schemes have changed very little during the last several years, although they are much faster and more accurate. The three most commonly used methods are still voltage to frequency conversion, dual integration conversion, and successive approximation.

A major area of A/D improvement is in signal resolution. Once 10- and 12-bit measurement resolutions were fairly typical, but today more and more 14- and 16-bit devices are seen. This means that each measurement can be resolved to much smaller increment changes.

One of the biggest improvements of all, from the standpoint of DLs, is the use of autocalibration. Today's DLs perform zero and full scale calibrations of the A/D converter at specific intervals. This helps to eliminate the problems of drift and reduces the frequency of required calibration. Other improvements in A/D conversion techniques involve noise reduction schemes, temperature compensation, voltage offset compensation, and drift correction.

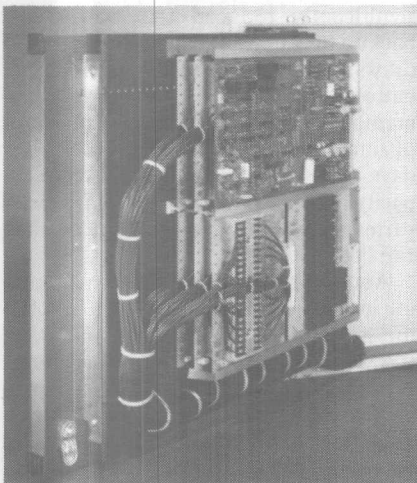


Figure 2. The Netpac 100-Plus-Channel Multimodule distributed ADC.

An interesting development is the increasing use of distributed A/D converters (Figure 2) which can be placed in the field right at the sensor's location. Thus, the A/D conversion is done at the sensor, and the resulting digital signal is transmitted to the DL via a single twisted pair of wires or fibreoptic cable.

The benefits of this approach include:

- ☐ allows error checking, which eliminates measurement errors due to long cable runs;
- ☐ cuts installation costs by eliminating the need for expensive cabling (e.g., T/C extension wire);
- ☐ eliminates the need for large equipment racks because the DLs are smaller without the A/D electronics; and
- ☐ allows parallel sensor scanning with multiple A/Ds, and increases system throughput.

Communications

In the area of DL communications, important changes have occurred in interfaces to devices such as host computers, PCs, printers, terminals, and so on. Whereas at one time DLs were strictly standalone devices, today, most DLs include one or more serial ports as standard. Typical communication interfaces used include RS232C, IEEE-488 (GPIB), current loop, and some proprietary types.

Modern DLs offer flexibility in storing and outputting data so that host computers can use the information. By accessing the DL through an interface port, a host can bring data in to manipulate and analyse it. This turns the DL

into a powerful computer front end and frees up host computer time for other tasks. In addition, host computers can now use the serial ports to download a data acquisition request to DLs. And, many DLs now allow their set-up functions to be programmed over these ports, which means the DL can be located at an industrial site and programmed from a remote office.

Intelligent additions

Today's DLs, with their powerful microprocessors, have more intelligence than ever before. Almost all of them can make measurements and scale, linearise, and convert them to usable engineering units. Available math functions include: algebraic, Boolean logic, trigonometric, statistical analysis, and fast Fourier transforms. These capabilities eliminate the need for collecting reams and reams of raw data. Instead, data is reduced to more meaningful information upon which decisions can be based. Data reduction also minimises on-board memory requirements and allows data storage for longer periods of time.

Being able to do them in a DL saves time and effort for many applications. It can also eliminate the need for additional computers, software, and manpower.

Software

Probably the most prevalent trend in DLs is the introduction of software that allows PCs to interface with DLs (Figure 3) and are, typically, menu-driven packages for programming the DL, retrieving data from it, and displaying information. The packages turn the PC into either a realtime operator's console or an engineering workstation, and combine the accuracy and ruggedness of a DL with the flexibility of the PC.

The packages are written to maximise the data acquisition and data logging system. For example, in pilot plant applications, programs for DLs can be changed easily and rapidly as more about the application is known. In lab work, data can be transferred quickly to the PC without manual entry for analysis.

DLs also are available that use higher



Figure 3. Auto Master comprehensive software package which allows PC to run as data acquisition system.

Modern DLs can also do complex calculations such as ASME steam tables, gas flow functions, sterilisation factor, dew point, and statistical process control. Previously, these calculations had to be made by hand or in a computer.

level languages. IBM PC based DLs are the most common in this area, but some industrially designed standalone DLs include user programming space for languages such as Basic and Fortran. These languages allow the user to format reports, do special complex calculations, and provide operator information for startup, shutdown, alarm activities, and so on. Use of higher level languages also allows the user to customise a DL for specific application. ☐

Acurex Corp is represented in SA by Etch-
tronics.

Power line filters/surge suppressors

Figure 2 shows the comparative performance of Pontins filters against the energy spectrum of mainsborne interference spikes and typical radio frequency interference filters measured into their recommended 50 Ω load.

Using Pontins filters some 90 % of

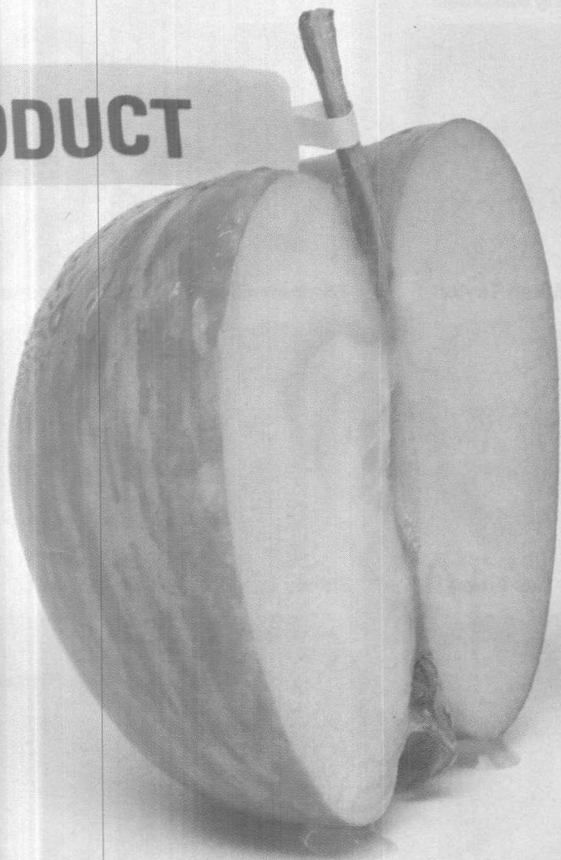
mainsborne interference can be eliminated: even many of the problems previously requiring super isolation transformers at 6 - 10 times the price of the filter. ☐

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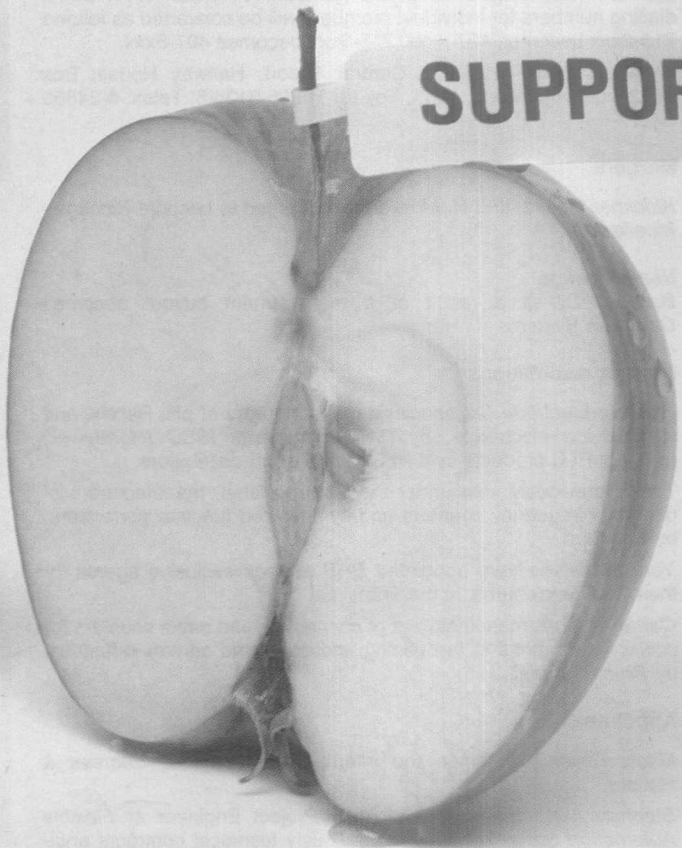
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PULSATIONS

New addresses and numbers

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Siemens new head office phone number: (011) 407-4111. Direct dialling numbers for individual members will be converted as follows 715-2xxx becomes 407-4xxx, 715-3xxx becomes 407-5xxx.

Meter Systems to: Grand Central Airport, Halfway House; Box 1562, Halfway House, 1685; Tel: (011) 805-3134/5; Telex: 4-24856 SA.

Mergers

Klockner-Moeller and *H. Moeller* have merged to become *Klockner-Moeller*.

Name change

BarlowCAD, as a result of a management buyout becomes *Cad/Cam Systems*.

New representations

Phoenix Electrode Co, specialist manufacturers of pH, Redox, and specific ion electrodes, by *IMC Instruments ISSC (Honeywell)* range of PLC products by *CHI Control* as sub-distributors.

Tabor, previously sold under the *Kontron* label, manufacturers of universal frequency counters and synthesized function generators, by *Specitec*.

York Pressings have appointed *BHD* as their exclusive agents for their DMC enclosures, in the Transvaal.

Carrier Kheops manufacturers of connectors and cable couplers for power applications in the mining, industrial and control industries, by *Procom Aerial*.

Appointments

Mitch Taylor has joined the internal sales staff of *Endress & Hauser*.

Stephen Allen has been appointed Project Engineer at *Flexible Automation Systems*. He was previously technical contracts engineer with CKF, process control systems suppliers of Industria.

Paul Woodhead has been appointed Sales Engineer, programmable logic controllers, at *Flexible Automation Systems*.

Les Freed has joined *Negretti & Zambra* as Manager of their Natal branch.

Temperature Controls has announced the following appointments:

Sidney Ireland as Sales Engineer for the near East Rand region.

Olly Rix as Sales Engineer West Rand region.

Integrated Control Systems has made the following appointments:

Arthur Gisby as Sales Engineer for the Transvaal,

Johan van den Berg as Manager of the Natal operation.

Both have many years' experience in sales and commissioning of electric and electronic control systems.

Procom Aerial has announced the following appointments:

Francis du Plessis Personal Assistant to the Sales and Marketing Director

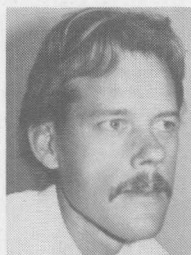
Lawrie Rodwell Product Specialist for the newly acquired Carrier Kheops agency

Zyn Dry has been appointed Sales Engineer, specialising in HV couplers and mining equipment

Mike Thomson, Financial Director to the Board of Directors

Garth Fritzjohn Sales Engineer operating from the Klerksdorp branch.

H. Rohloff has announced the following appointments:
John Duckles Project Consultant for HBM Testing
Geoff Ireland Senior Project Consultant for HBM Testing and Measuring equipment.



Mitch Taylor



Stephen Allen



Paul Woodhead



Les Freed



Sidney Ireland



Olly Rix



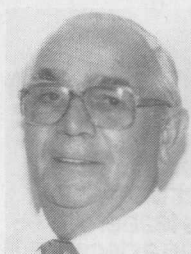
Arthur Gisby



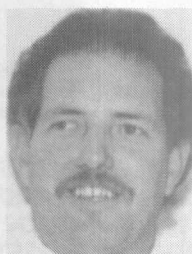
Johan van den Berg



Francis du Plessis



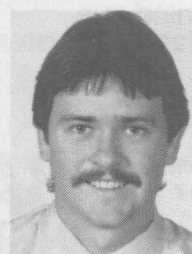
Lawrie Rodwell



Zyn Dry



Mike Thomson



John Duckles



Geoff Ireland

Solution to 'Bridging the gap'

Let R be the radius of the arc of the circle, which forms the bridge and let W be half the width of the river.

The coordinates of point A (x, y) are:

$$(W, (R - 10)) \quad (1)$$

and of point B:

$$((W - 27), (R - 1)) \quad (2)$$

From the equation of a circle:

$$R^2 = x^2 + y^2$$

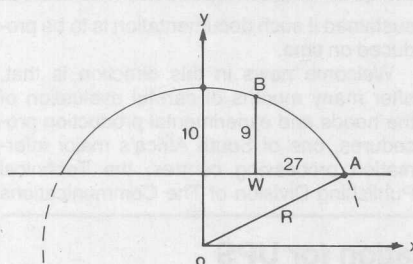
from (1) we have:

$$R^2 = W^2 + (R - 10)^2$$

$$\therefore R = (W^2 + 100)/2 \quad (3)$$

and from (2) we have:

$$R^2 = (W - 27)^2 + (R - 1)^2 \quad (4)$$



Substituting (3) we obtain:

$$W^2 - 60W + 80 = 0$$

and therefore $W = 20$ or 40 .

$W = 20$ must be rejected since 27 m from the bank must be less than halfway across.

If $W = 40$ the river is 80 m wide.

The first correct answer opened was sent in by W. Swart, P.O. Box 8412, Pretoria 0001, who will shortly be receiving his Soar model D₂M₂ high speed autoranging digital/analog multimeter.

Brain teasers

Hindsight is an exact science. Consequently the answers to the following brain teasers will make you kick yourself. The immediate reaction, of course, is very predictable. You will seek to impose your new superiority on those feckless friends, colleagues, and relatives who are unfortunate enough to have neither your superior intellect nor the answers:

1. What familiar English word is invariably spelt incorrectly by virtually every reader of *Pulse* and *SA Measurement & Control*?
2. Jack's beanstalk increased its height by 50 % on the first day. On the second day it increased its height by 33,33 %, on the third day by 25 %, and so on. How long did it take to achieve its maximum height of 100 times its original height?
3. Their are three errors in the statement of this puzzle. You must detect all three of them to receive full credit.
4. What is the exact opposite of 'not in'?
5. How many months have 30 days?
6. Two girls, born on the same day of the same month in the same year of the same parents; were not twins. Explain.
7. Determine the next three terms of the sequence 12, 1, 1, 1, . . .
8. Two coins together total 55 cents. One coin is not a fifty cent piece. What are the coins?
9. Two missiles approach each other on a collision course, one travelling at 3500 km/h and the other at 2500 km/h. If they start at exactly 961 km apart how far are they apart 1 minute before collision? (Without paper, pencil, or calculator).
10. Divide 50 by $\frac{1}{2}$ and add 3.

Answers in August.

Weil secures Camille Bauer agency

Camille Bauer, the leading Swiss company engaged in industrial instrumentation and process control, have recently appointed Weil Electronics (Pty) Ltd as their exclusive agent for south Africa.

Camille Bauer manufacture instrumentation equipment for the gathering and conditioning of physical variables. The range comprises transducers, transmitters, converters, isolation units, totalisers and power packs for two-wire transmitters. Instrumentation for displaying and processing of measured variables include recorders, indicators and alarm units.

The range of products incorporates the latest technologies such as all-automatic placing of surface-mounted (SMDs), in-line laser-trimming and ultramodern testing methods.

50 years of F & P

1987 is a milestone in the history of Fischer & Porter and its local South African representative, Datatrol, since Fischer & Porter celebrates its 50th year of operation, while Datatrol celebrates its 20th year of representation.

Fischer & Porter has come a long way from its beginnings in a Pennsylvania garage 50 years ago, where Kermit Fischer and George K. Porter developed mass production techniques for the manufacture of reproducible precision bore glass tubing – giving birth to the ubiquitous variable area (VA) flowmeter as an accurate and reliable basic flowmeter for liquids and gases. Although Fischer & Porter has, since those early days, been pioneers in many other aspects of flowmetering technology, the VA meter has given reliable and cost effective service in what must be millions of installations.

Today, the VA meter stands as a testament to Kermit Fischer who must surely be considered the Henry Ford of VA meters. Although earlier work was being carried out by several people over the preceding 70 years, it was not until Kermit Fischer's development in 1931 of the carbon mandril method of producing taper glass tubes that the VA meter became a viable product. Initially, glass tube VA meters had to be individually calibrated and it was not until 1950 that the need for individual meter calibration was eliminated with the development of standardised tube and float geometrics that assured predictable performance characteristics.

Fischer & Porter has always been a leader in the process instrumentation field. While a Dutch company was working on development of the magnetic flowmeter in Holland, Fischer & Porter was actively developing the same device in America and introduced its first magnetic flowmeter to the market in 1954. Since then it can justly claim many firsts in the development of this technology to where it is today, i.e. d.c. pulse excitation, field characterisation, auto zero, non-wetted (capacitive) electrodes, true permeable material compensation and the wafer style body.

Having grown from a garage operation to a multi-national organisation of 19 subsidiaries with 4500 employees producing a range of over 2000 products, Fischer & Porter can rightly claim to be one of the leading manufacturers in the world for process control instrumentation.

Millions of Dollars were spent by Fischer & Porter in developing computer systems and a microprocessor based line of modular instrumentation to complement its measurement products and meet the needs of industries, growing sophistication and need for plantwide management and control of process plants.

It is, however, interesting to note that, through all the changes that industry expects and demands from its suppliers, the variable area flowmeter is still with us and still affords the least expensive method of flow measurement in industry today. To many people not familiar with its theory it is just a glass tube indicator, but time has shown it to be the most popular and versatile form of flow measurement. Its only limitation is its compatibility with the product being measured and in recent years the introduction of low cost metal tube construction and teflon liners has increased its acceptance in a great many applications that were previously not possible.

To Kermit Fischer and George K. Porter 50 years ago, the VA meter was their bread and butter until other products were developed to expand and enhance their measurement capabilities in the industrial and municipal fields. Today, the VA meter is still the basic flow measuring system, and new developments only serve to increase its acceptance in all industries – itself a fitting enough tribute to the foresight of Kermit Fischer – the man responsible to this day for the development and acceptance that the VA meter has achieved over the last 50 years.

8707 – 046 on Service Card

8707 – 047 on Service Card

Technical documentation production services for manufacturers

The high standards of accuracy and professionalism required in the preparation of technical documentation and drawings, whether for tender purposes or for an Operator's Manual/Handbook for an important piece of machinery or parts catalogues, have placed a demand on the limited number of people competent to do such work which cannot be

sustained if such documentation is to be produced on time.

Welcome news in this direction is that, after many months of careful evaluation of the needs and experimental production procedures, one of South Africa's major information processing centres, the Technical Publishing Division of The Communications

Group, is now offering a fully experienced and staffed service to handle commercial and industrial documentation for clients, from a single document to major handbooks, service manuals and similar essential productions. The editorial staff includes experienced technical writers, translators and specialised editorial consultants; the Technical Drawing/Design department has technical illustrators and highly trained CAD operators using the latest technology in computer-aided drafting and design.

Advantages to the client with regard to security disc storage and ease of updating are numerous.

Sound project management is achieved through a combination of specialist management expertise ranging through publishing, finance, marketing, computers and production.

Wide ranging advantages and related services are given through the Group buying power and assistance to clients in the import and export of their products.

For further information contact Mel Ellis at (011) 835-2221, or use the Reader Service Card.

8707 - 048 on Service Card

Standard specification for UPS

In line with the Government's strategy for the development of the South African electronics industry, the Standing Committee for Electronics (SCE) is inviting local manufacturers of uninterruptible power supplies (UPS) and other interested firms to submit a proposal to manufacture UPS for the various agencies of the State.

Proposals which should reach the IDC (marked for the attention of Mr E. Stacey) prior to 14 August 1987 should include the following information.

- ☐ the proposer's comments on the Standard Specification for UPS, copies of which are obtainable from Mr P. Truter (011) 883-1600;
- ☐ the technical specifications of the proposer's products, highlighting any new technological approaches, and pointing out any deviations from the standard specifications;
- ☐ the proposer's production capabilities and facilities;
- ☐ the proposer's development capabilities and facilities;
- ☐ the proposer's local content plans expressed in monetary terms for both manufacture and design/development; and
- ☐ the prices and delivery time scales of the proposer's products.

Products with a high local content will be

favoured, particularly those locally designed and developed.

It is estimated that a capacity of 10 000 kVA will be installed per annum by the agencies of the State in sizes covering the full spectrum.

The SCE's intention is to purchase uninterruptible power systems from a selected but limited number of approved suppliers.

For further information contact Mr I. Kruger, by telephoning (012) 341-1311.

8707 - 050 on Service Card

Low profile scale

Fully manufactured locally, under licence to Riede Systems, SA Automation has added a new single-idler belt conveyor scale with a low profile feature enabling mounting into shallow conveyor structures.

Enhancing the company's already extensive range of belt scales, this low cost model WE 15 is of a light construction suitable for moderate feed rates and lower duty.

Three system configurations are available:

Rate only scale system, non speed compensated - recommended for service in constant speed conveyors and weighbelt feeders where no totalisation is required.

Totalising scale system, non-speed compensated - for use with constant speed conveyors and weighbelt feeders where totalisation is required.

Totalising scale system, speed compen-

sated - for service with varying belt speeds where totalisation is required.

The Riede model WE 15 belt scale frame employs a rugged, torsionally rigid carriage assembly supporting one idler. Pivot members are rubber trunnion type, sealed and impervious to product accumulation and weather. A heavy cross-shaft through the pivots eliminates carriage twisting from off-centre loading or tracking. A precision strain gauge loadcell, applied in tension, provides overload protection to 200 % of rated capacity.

Further information from SA Automation.

8707 - 051 on Service Card

Devers' training centre

Devers' training centre, founded in 1979 to reduce the skills' shortage in South Africa by offering a range of courses in instrumentation and control systems, has now accepted its 1000 th student. The initial three courses offered in 1979 have been expanded to a range of sixteen set courses covering a number of subjects, typically pneumatic instrumentation, digital control systems, flowmeter engineering and apprentice trade test preparation.

Courses concentrate on practical issues. Devers' premises at Wynberg (Johannesburg) offer extensive facilities for laboratory and problem-solving sessions on conventional and computer-base instrumentation. On occasion, courses have been held on the premises of major users of instrumentation, when there has been sufficient demand, and special courses have been developed to cover specific requirements.

Enquiries to: A.F.H. Devers.

8707 - 049 on Service Card

BPI installs PLC test bed

The installation of a 984 test bed in its Boksburg premises at a cost of more than R350 000 means that Bateman Process Instrumentation can now offer a fully localised repair service and backup for all its 984 PLC systems. This raises the already high level of local serviceability from 95 % to 100 %.

The 984 sort station is a highly specialised array of test equipment, software and jigs designed to identify system faults rapidly to component level.

Tests available include functional checks on user, state and executive memory, as well as FIFO logic memory. The correct operation of memory protect devices and mem-

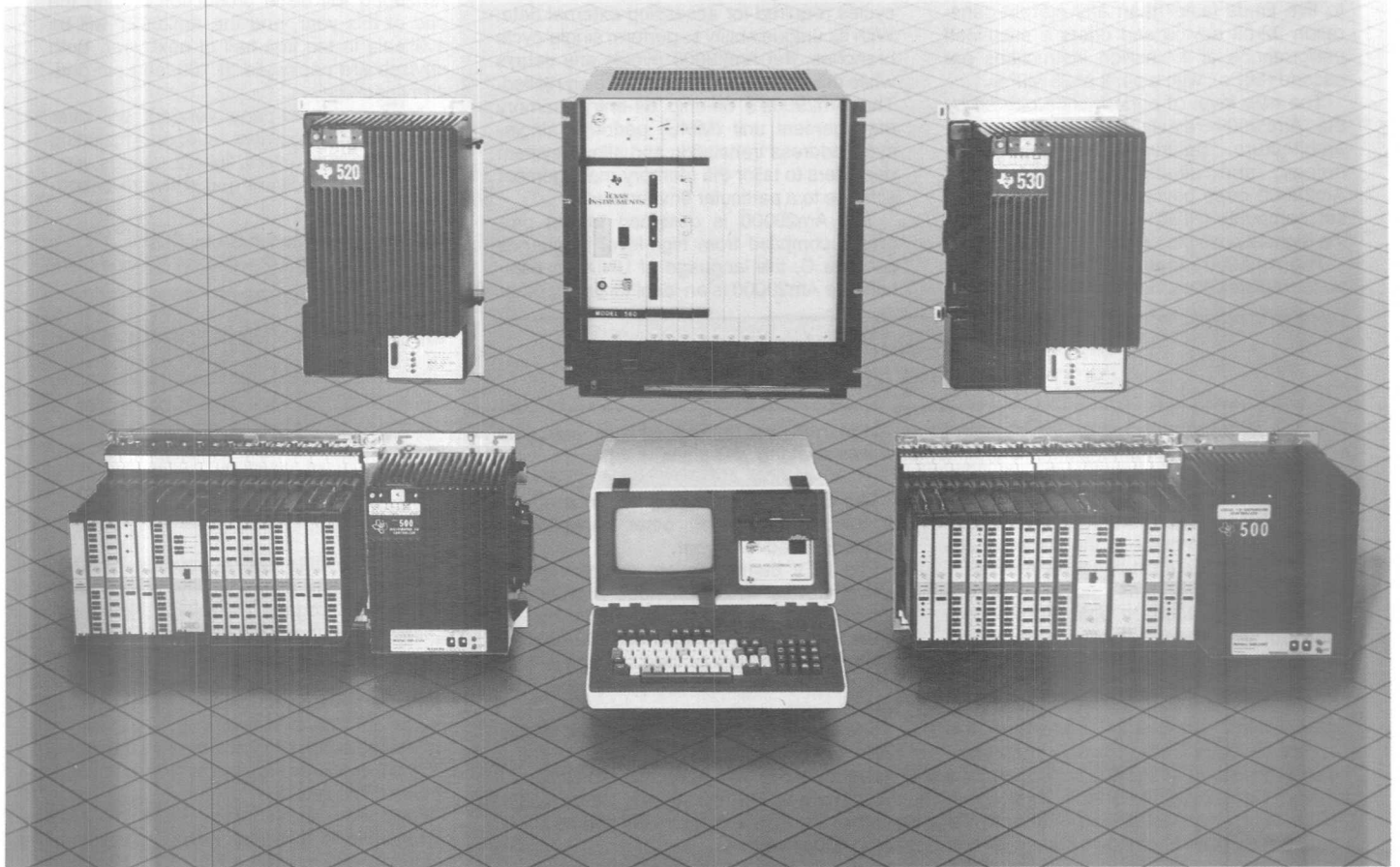
ory battery backup are also tested.

The test software for the CPU board includes full functionality tests on all software logic functions and logic function blocks, as well as a check on system clock frequency. All boards in the system are tested to a similarly comprehensive level.

The 984 sort station includes the following functional elements: 100 MHz signal display, digital metering and counting, various power supplies, frequency modulated signal generation, input/output racks and model jigs, remote input/output attenuation, master 984 simulation, programming tools with display, and test/simulation software.

8707 - 052 on Service Card

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8707 – 053 on Service Card

PULSE/SA MEASUREMENT & CONTROL – July, 1987 55

32-bit microprocessor operates at 17 MIPs

AMD's new generation of 32-bit CMOS microprocessors is claimed to operate three to five times faster than any current-generation 32-bit device and offers a sustained performance of 17 million instructions per second (MIPs), with a peak of 25 MIPs.

The new level of performance offered by the Am29000 results from a streamlined architecture, optimising compiler technology, and simple instructions. The Am29000 goes beyond reduced-instruction set computer (RISC) concepts to achieve the highest possible processor performance.

The Am29000 features 192 general-purpose register files, larger than any other

commercially available microprocessor. This expanded register file minimises the wasted cycles required for accessing external data. With its unique ability to perform single-cycle branches, the Am29000 avoids any delays while the instruction pipeline is being refilled. The Am29000's on-chip 64-entry memory management unit (MMU) performs single-cycle address translation and allows system designers to tailor the memory-management scheme to a particular environment.

The Am29000 is designed to run programs compiled from high-level languages such as C, the language of UNIX. In addition, the Am29000 is an ideal target for other

high-level languages, such as Fortran, Pascal, and ADA.

The Am29000 is the first device in a family of high-performance microprocessors and peripherals, which also includes the Am29027 Arithmetic Accelerator. The Am29000 will be in production around the end of this year, and the Am29027 will be available in the first half of next year. Both devices are packaged in 169-lead pin-grid-array packages.

AMD and third-party vendors will offer complete development support, including compilers, assemblers, linkers, loaders, simulators, and hardware and software debuggers.

AMD is represented in SA by SCD.

8707 - 056 on Service Card

Camera solves ship's electrical overheating problem

The new EEV thermal camera, which sources its image from heat rather than light, is proving of value in fields other than fire-fighting, for which it was primarily designed.

The camera was recently used on the Safmarine-owned SA Sederberg, where modifications had been made to the electrical distribution system to try to conserve energy.

Overheating problems had been experienced with a distribution board for nearly a year but the manufacturers, despite repeated attempts, were unable to locate the source of the problem.

To assist in locating the 'hot spot' Telkor Sales, which markets the camera in this country, sent its Cape Town Branch Manager, John Brown, to the SA Sederberg for a trip from Cape Town to Port Elizabeth.

After a few nautical miles out of port, the camera was used to pinpoint the fault - and did so immediately. Mr Spit, Safmarine's electrical engineer, was able to conclude that the problem was one of self-induction and that the matter had now to be referred to the switchboard manufacturers.

The EEV camera succeeded in a matter of minutes where all other conventional methods failed for a year.

The EEV camera is an electromagnetic optical device which provides a television quality image immediately visible to the viewer. It can also be attached to a monitor to enable observers to view the image projected by the camera away from the heat source.

The camera is hermetically sealed and is protected against shock.

Great interest has already been shown in the camera by fire-fighting and safety authorities as it is able to pinpoint the source of the fire in dense smoke.

The EEV camera can operate in excess of an hour on a portable battery pack in general ambient temperatures of up to 80 °C.

8707 - 054 on Service Card

Modular measurement system

The Hameg HM 8000 series, is a modular test and measurement system centred around a mainframe which accommodates two modules of the system.

The mainframe provides a total of eight independent floating voltages, so that each plug-in module is fully operational immediately after insertion into the mainframe.

Currently nine modules are available in the range:

Digital multimeter

The HM 8011 is a 4½-digit DMM providing a.c. and d.c. voltage and current measurement, as well as resistance, in 26 ranges. The instrument provides true rms measurement capability and has a d.c. accuracy of 0,05 %.

Milliohm meter

The HM 8014 has a measuring range from 0 - 200 mΩ to 0 - 20 kΩ in six ranges with a 0,1 mΩ resolution.

Frequency counter

The HM 8021-2 provides frequency measurement over the range 0,1 Hz to 1 GHz and period measurement from 1 μs to 99,9 s with a sensitivity of 20 mV rms on an 8-digit LED display.

Distortion meter

The HM 8027 covers the frequency range of 20 Hz to 20 kHz and provides distortion measurement to within 0,01 %.

Other plug-in modules in the range include function generator, sine wave generator, pulse generator, audio generator, and triple power supply.

Further information on Hameg from South Continental Devices.

8707 - 055 on Service Card

Universal logic programmer

Digelec's model 860 logic programmer is claimed to be the first stand-alone programmer that has on-board support for all 20-, 24-, 28- and 40-pin PLDs manufactured by Altera, AMD, Cypress, Harris, Intel, Lattice, MMI, National, Ricoh, Sprague, Signetics, TI, and VTI.

The removable socket module assures maximum future expandability, and enables the user to program PLDs with higher pin counts or in different packages (PLCC) - just replace the socket, rather than the whole programmer. In addition the Softpack cartridge, externally mounted, represents a unique solution to software revisions allowing update of the programmer with the latest software in just two to three seconds without opening the unit.

Equipped with 64 k-byte standard RAM, expandable to 256 k-byte, the programmer can accommodate more than 3000 test vectors that may be applied to the PLD under test. The security fuse can be blown either manually or automatically after programming is completed.

Extensive device testing includes: blank/illegal bit check, misplaced/reversed device, current overload, continuity, checksum, vector test, preload, and array verify.

Further information from Altech Instruments.

8707 - 057 on Service Card

IC replacement and alternative source guide

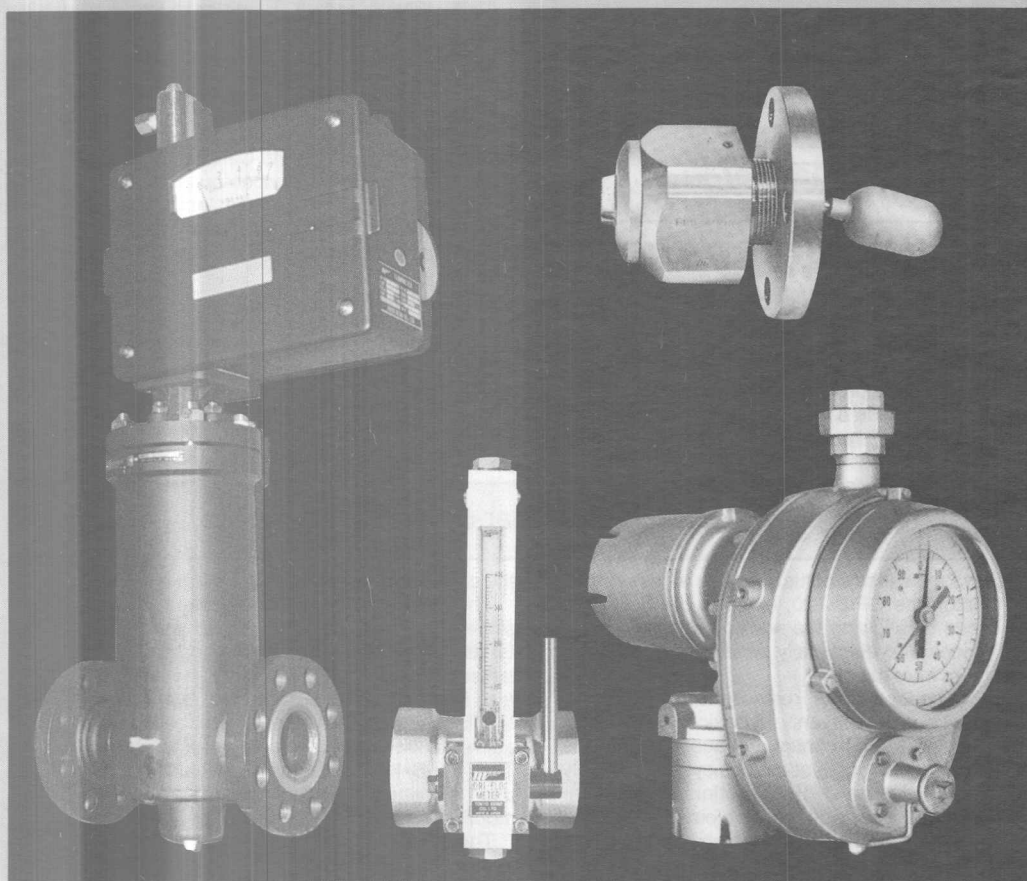
A new IC replacement and alternative source guide from DATA Book, cross references over 200 000 replacement integrated circuits.

The publication which is updated and published twice-yearly, includes digital, interfaces, microprocessors, audio/video, linear, and memory ICs, from more than 130 manufacturers.

Further information on the DATA Book range of publications which includes specification/data book on ICs, discrete semiconductors, and components, is available from Allied Electronic Components.

8707 - 058 on Service Card

8707 - 059 on Service Card →



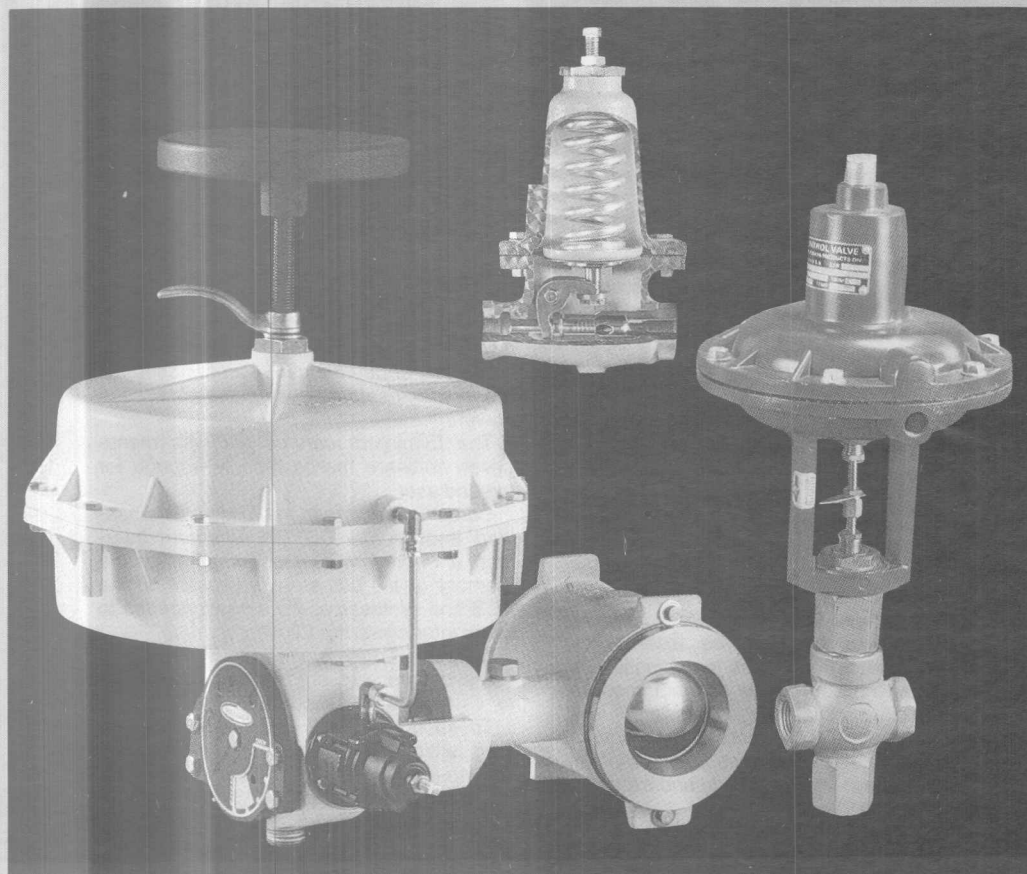
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Low-cost multi-purpose logic analyser

The new K50 logic analyser from Gould is a low-cost, multi-purpose instrument which offers a high degree of performance, including easy user configuration of numbers of channels and bandwidths, in a small, lightweight package.

The Gould K50 can be configured from the front-panel keyboard from 32 channels at 25 MHz (1 k-samples/channel) to eight channels at 100 MHz (4 k-samples/channel). It can capture complex timing, state and microprocessor-orientated software events, including glitches down to 5 ns, which are stored in a separate memory and can be unambiguously displayed alongside timing data.

Three external clock inputs with qualifiers are provided to allow the demultiplexing of complex events, while Gould's Trace Control TM feature offers four levels of complex event definition with four trigger words plus one glitch word. Data may be defined as valid only if it is stable for a user-defined number of clock cycles with trigger and re-start filters.

The K50 features a high-resolution, non-glare 178 mm CRT display which can show up to 17 channels across the complete memory or be expanded for detained viewing.

Channels or channel groups can be uniquely labelled, and two independent on-screen cursors plus a trigger marker are used to indicate absolute and relative data position and value.

The major instrument functions are con-

trolled by dedicated front-panel keys, while soft keys guide the set-up of individual parameters. The 'search' and 'compare' functions display their results as highlighted events.

The K50 is supplied with 8-channel high-impedance probe pods (1 M Ω , 5 pF), which each provide a TTL or ± 50 V. Data skew is less than 2 ns across a pod, and typically less than 4 ns across the full instrument.

IEEE-488 bus expander/isolator

National Instruments' new bus expander/isolator, the GPIB-120, expands the IEEE-488 bus by allowing the addition of 14 more devices and electrically isolates one bus system from the other.

The two major restrictions of the IEEE-488 bus are that only 15 devices can be connected to one contiguous bus, and that the total cable length of the bus system can only be 20 m. The GPIB-120 offers an inexpensive solution to these problems by allowing an additional 14 devices to be added to the bus and an additional 18 m to the bus length. Multiple GPIB-120s may be used to access even more devices.

The GPIB-120 also isolates an instrument or group of instruments from the controller, and therefore solves measurement problems when making small-signal measurements or when operating in very noisy environments. It ensures that small-signal measurements are accurate regardless of

The new analyser is supplied complete with IEEE-488, RS232 and Centronics ports plus trigger, re-start and video outputs. Also included is a battery-backed non-volatile memory which saves the current stored data, three reference data sets and 16 set-up configurations.

A range of microprocessor analysis packages is available, including disassembler software and interface adaptors for the Z80, 8085, 6502, 6809, 8086/8 and 68000 processors.

Further information from Altech Instruments.

8707 - 061 on Service Card

the conditions around the controller.

The GPIB-120 is particularly easy to use since there are no switches to set. The GPIB-120 detects the location of controllers, talkers, and listeners and configures itself. It also has front panel LED indicators showing the location of the system controller, the active controller and the source handshake. The GPIB-120 operates transparently to user software, therefore making software modifications unnecessary.

The GPIB-120, the newest member of a family of IEEE-488 interface solutions that include bus extenders, converters, and testers, is available from Westplex Computers.

8707 - 062 on Service Card

CMOS DIP switch

The DS1290, from Dallas Semiconductor, is a CMOS DIP switch that is controlled by software, thus eliminating hand setting of mechanical switches. Contained in a 14-pin package, it replaces the equivalent of an eight-station manual DIP switch.

Called the Eliminator, the DS1290 allows the set-up of switches to be automated by software. Inherent in that is the ability to interrogate and verify the correct settings.

The DS1290 offers users the choice of re-programming the switches on each system power-up or maintaining the settings until they need to be changed. The switches will not lose their settings even in the absence of power.

The Eliminator can be set with menu-driven software that is friendly enough for the end user.

Communication with the Eliminator is handled through the DS1206 Phantom Interface, a 14-pin CMOS circuit which takes the memory or I/O bus already present on the PCB and synthesizes the signals needed to set or interrogate the Eliminator.

Only one DS1206 interface is needed to communicate with any number of Eliminators, which expand modularly.

To ensure that the switches do not lose their settings, the Eliminator is nonvolatile, with an embedded lithium energy source remembering settings in the DS1290 for more than 10 years, even if the system's power fails.

Further information from Promilect.

8707 - 063 on Service Card

ATE switching systems

Racal Dana has announced a major enhancement to its highly successful 1250 switching system. Three new versions (models 1251, 1252, and 1254) combined with the slave (model 1253) enable up to eight chassis to be configured and controlled locally from a single chassis or one GPIB address. With 280 channels per chassis, the Racal Dana switching systems now have the capability to handle extremely large automatic test and production applications.

Fully compatible with both the software and the switching modules of the 1250, each mainframe or slave can accommodate up to 14 modules using any combination of the 17 different modules available. This wide range provides signal switching for microwave (d.c. to 26.5 GHz), RF, audio, high voltage, high current, low level, video and digital I/O. Modules are available for a number of applications including scanning, matrix, SPDT and tree-switching.

Some of the range include an intelligent front panel with a 16 character alphanumeric display permitting set-up and editing, under local GPIB program control with total status display of any module. If on the GPIB bus then program control is through simple 'English Language' type commands which support complex and digital control applications.

The system provides programmable confidence testing as well as self test routines. The design is completely modular, giving exceptionally low MTTR. RFI has been significantly reduced over previously available systems for sensitive switching networks or environments.

A nonvolatile memory can store up to 63 complete relay set-ups, allowing fast test configuration changes and minimising the requirements for a separate GPIB controller. A 10-line analog bus permits internal interconnections between modules, thus minimising external wiring and simplifying switch system design.

A single 1251 switch chassis can be configured as an extended matrix (4 x 70) or as a large scanner/multiplexer (280:1). Using seven slaves this can be extended to 2240:1. Alternatively, a combination of switching network using different modules can be fitted within a single chassis.

The modular construction and common modules and software enable users of the 1250 series to easily upgrade and expand to the larger 1251 series.

Grinaker Electronics Agencies are the Southern African representatives.

8707 - 060 on Service Card

Superior Instrumentation for Acoustics and Vibration



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- Vibration measuring and monitoring instruments.
- Audiometric calibration instruments for speech and hearing.
- Network airport noise monitoring systems, with management planning software.
- Precision measuring microphones, preamplifiers, power supplies, instrumentation amplifiers, acoustic intensity probes, calibrators and accessories.



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Locally designed head-mount transmitters

A new range of locally designed and manufactured head-mount thermocouple and RTD linearised and nonlinearised temperature transmitters has already produced in excess of half a million rand of export sales revenue since its introduction to the international market nine months ago. These units have been sold successfully into the local market since 1984.

Brand-named for export, the temperature transmitters, designed and manufactured locally by Tempo Instrumentation in conjunction with Contronics and distributed worldwide by Contronics under the 'Pyrotec' label, are currently available as non-isolated head-mount units in three basic models: linearised thermocouple, nonlinearised thermocouple, and linearised RTD. DIN rail-mount versions, with RFI/EMI suppression as standard, and plug-in range modules, are also available.



A sample of the Pyrotec range of head-mount temperature transmitters.

All of the Pyrotec range of two-wire transmitters are designed to provide a 4–20 mA output signal and to operate from any power supply within the range of 12–50 V d.c. An in-circuit LED provides an indication of both loop continuity and output signal strength. Reverse polarity protection is also provided, together with output transient protection.

Thermocouple transmitter

Designed to fit directly into a thermocouple head, or in a DIN rail-mount housing with RFI/EMI suppression, the transmitter bodies are colour coded according to ANSI colour code requirements, with models suitable for type B, E, J, K, N, R, S, T, W, W3 and W5 type thermocouples. Both the linearised and nonlinearised models incorporate cold junction compensation (CJC), with upscale burn-out detection to 28 mA, provided as standard, whilst downscale protection to 2 mA is provided on request.

The linearised thermocouple transmitter model makes use of a 7 break-point characterisation circuit to provide a 4–20 mA output which is linear with temperature to within 0.1 % of span. The CJC is characterised to follow the curve of the thermocouple over a

–20 to 70 °C range to give a typically 1:25 rejection (i.e. 1 °C in 25 °C or 0.04 in 1 °C).

RTD transmitter

In either the head-mount or DIN rail-mount housing RTD transmitter, positive feedback is applied to modulate the excitation current, in order to provide a continuous form of linearisation.

The DIN rail-mount version caters for both 2- and 3-wire RTDs with true lead compensation providing a 500:1 lead rejection factor.

General

Both the nonlinearised thermocouple model (TCTX) and the linearised RTD model (RTXL) have ± 25 % span and zero adjustments which are non-interactive.

Over 71 different standard ranges are available for the linearised thermocouple

transmitter (TTX), 79 ranges for the nonlinearised thermocouple model (TCTX), and more than 80 different standard ranges for the linearised RTD transmitter (RTXL).

Delivery is generally ex stock or within two to three weeks (dependent on the calibration ranges required) and the prices are R300 for the linearised thermocouple transmitter (TTX), R125 for the nonlinearised thermocouple transmitter (TCTX) and R120 for the linearised RTD transmitter (RTXL).

The future

With the RTXL, TCTX and TTX models now IS approved, work is already proceeding for fully IS approved RTXL and TCTX model with isolated inputs and outputs.

The ultimate goal, which is steadily being pursued, would be a world first: linearised, isolated, head-mount units, with IS approval and RFI/EMI immunity.

Spin-offs, from the current models, which will also be introduced in the near future include, amongst others, transmitters for mV, loadcells, and potentiometric inputs.

Further information from Contronics, Barry Smith (011) 609-4020.

8707 – 065 on Service Card

Solid-state flow sensors

A range of solid-state flow and temperature sensors, from Weber Sentec is suitable for all sizes of pipe and hose dimensions, liquid, gaseous and semi-solid media, as well as for most corrosive materials.

The Flow-captor sensors, type 42 and 44, have been designed for remote operation with the 'Flow-captor' switching unit type 4001 or modular 'Flow-captor' Eurocards for 19" carrier or rack mounting.

Equipped with two internal sensor probes, the unit operates according to the calorimetric principle and is suitable for pressures of up to 10 MPa.

One probe is electronically heated to be just above the temperature of the medium, whilst the second probe measures the medium's temperature. The temperature difference between the medium and the marginally heated sensor probe is measured and the difference is proportional to the medium's flow speed.

The power supply and the sensor conditioning signal is generated in the switching unit. Maximum distance between the sensor and control unit can exceed 100 m if required.

Contact Weil Electronics for further details.

8707 – 066 on Service Card

Overfill protection

Overfill is one of the biggest single causes of petrol terminal and refinery fires. Point level controls for overfill prevention can help eliminate dangerous and costly product spills that result from overfilling hydrocarbon bulk storage tanks.

The latest unit in a range of equipment from Drexelbrook, is a two-wire point level control system which includes a vessel mounted, two-wire transmitter with integrally mounted sensor. This unit is powered by a remote supply located in a separate receiver. Two sensor models are available, one rigid and one flexible, for mounting on either fixed-roof or floating-roof tanks.

When used with the standard Drexelbrook receiver, the system is self-monitoring for circuit failures and opens or shorts in the signal wires. This provides the user with a maximum degree of system safety and reliability. DPDT alarm contacts can be used to activate audible and visible alarms or to shut down pumps when the tanks are full.

The output signal from this overfill system can also be used to input various programmable controllers, annunciators or process computers.

The overfill prevention control provides a redundant, completely independent alarm, from the vessel's standard continuous level indication. Intrinsically-safe signal wires and transmitter are suitable for Class I Groups C and D (Div 1 and 2). Lightning and power line surge protection is also built in.

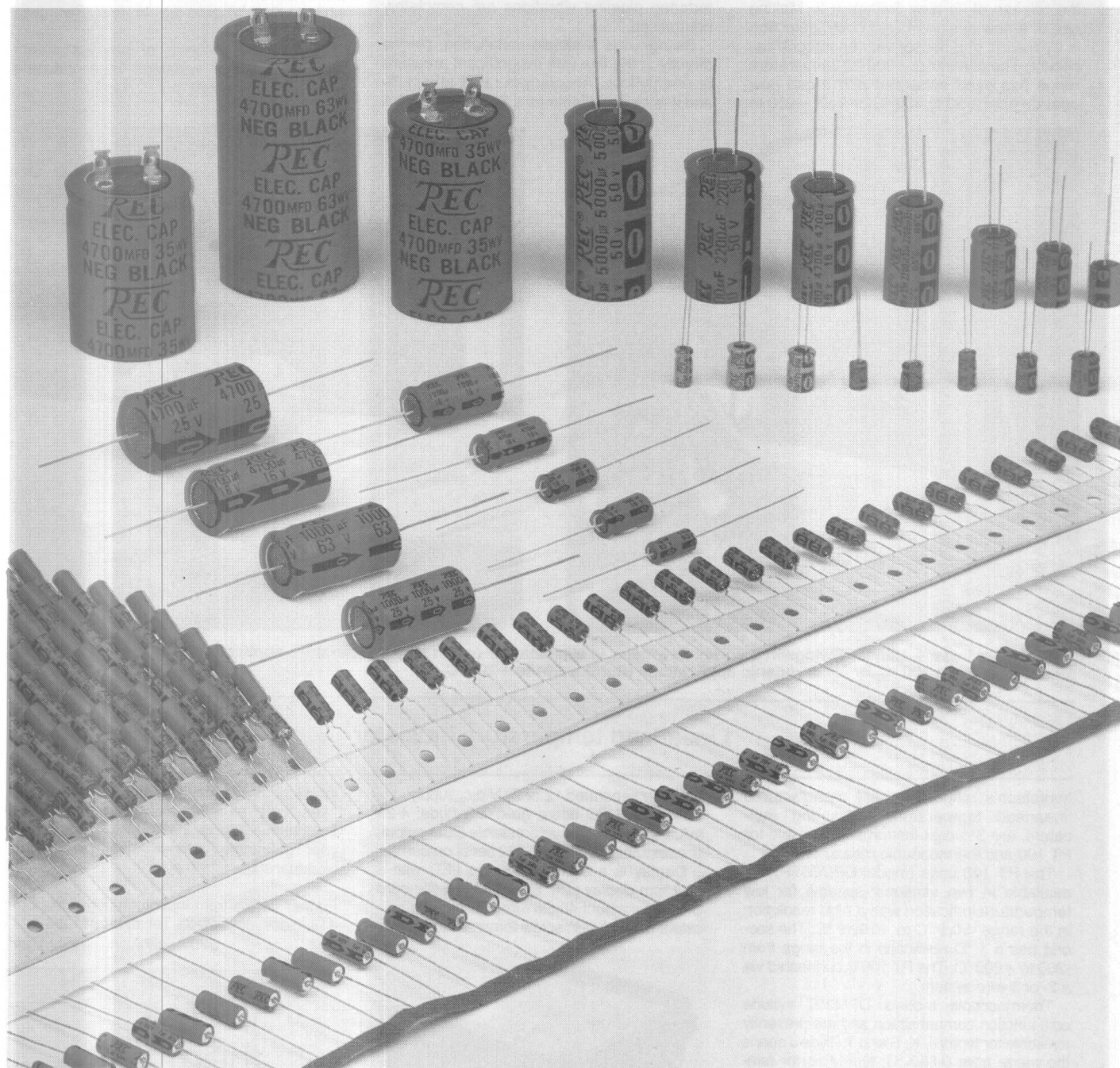
Further information from Protea Industrial Controls.

8707 – 067 on Service Card

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Tel: (011) 609-3035/9
Telex: 4-22154 Fax (011) 609-3059.

8707 - 068 on Service Card

PULSE/SA MEASUREMENT & CONTROL - July, 1987 61

Vortex flowmeter for extreme temperatures – cryogenics to superheated steam

Endress + Hauser has improved the capability of its Swingwirl vortex flowmeter with the release of its new Swingwirl II. Making use of a new design of bluff body, detection is by means of a sensor with an integral capacitor. The nominal 0 – 300 °C temperature range has been enhanced and it can now operate from –50 to 400 °C or from –200 to

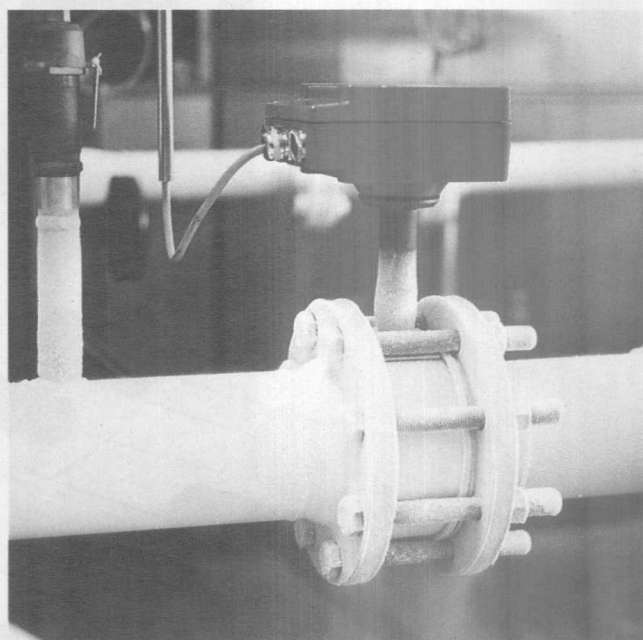
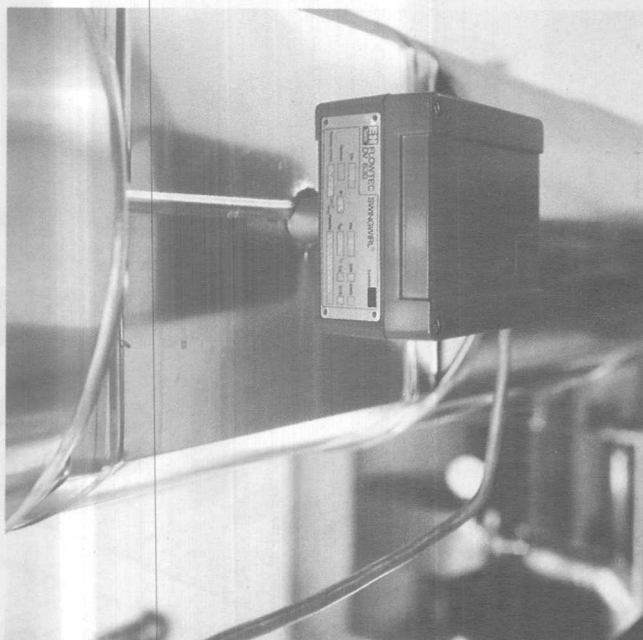
80 °C. Improved resistance to overload shocks in water or steam is featured and interfering pipeline vibrations are completely neutralised.

Swingwirl is a simple installation, placed directly in the line with insignificant pressure or energy loss. Accuracy is rated at $\pm 1\%$ and it is also available as a 2-wire 4 – 20 mA

transmitter. Outputs are 0/4 – 20 mA plus a pulsed output for totalising.

In addition, the new Endress + Hauser COMPART flow computer is available for flowrate measurement of compressible media using pressure and temperature inputs. COMPART is a multichannel device which can compute up to four Swingwirl flows.

Swingwirl monitoring of process steam and other liquid variables is a valuable energy management tool.



The new Endress + Hauser Swingwirl II vortex flowmeter is available for use in high temperature applications such as superheated steam (left) up to 400 °C, or for cryogenic applications (right) down to –200 °C.

8707 – 069 on Service Card

Linearised temperature indicator

Instrotech's range of locally manufactured linearised temperature measuring indicators, are 3½ digit instruments suitable for PT 100 and thermocouple measurement.

The PT 100 units (model DPM35TP) are available in two versions: suitable for low temperature indication with a high resolution in the range –50,0 °C to +199,9 °C. The second has a 1 °C resolution in the range from –200 to +600 °C. The PT 100 is connected via a 2- or 3-wire system.

Thermocouple models DPM35T include cold junction compensation and are presently available for types J, K, S and T. Type J spans the range from 0–650 °C; type K is for temperatures between –20 °C to 1200 °C; type S is linearised from 1000 to 1750 °C; and type T measures ranges from 0 to 300 °C or +30 to –230 °C for cryogenic applications.

The indicators can be supplied with an optional built-in relay with 2 capacity contacts for alternate use as on/off temperature controllers.

Auxiliary power supply is standard 200 V or 110 V a.c., or 9–12 V d.c. with an option of gal-

vanically separated 12 or 24 V d.c. supply.

Additional PC board options include: 4–20 mA; parallel BCD or addressable BCD output; or computer interface RS232 serial output.

Display is a high visibility red LED with a 14,2 mm display size. Enclosed in a standard DIN panel mount 48x96 mm housing, the indicators have plug-in screw terminals to simplify

installations and maintenance.

As with all other locally manufactured Instrotech products, the DPMs carry a full two year guarantee against faulty material or workmanship.

Further details from Instrotech (Pty) Ltd., Box 418, Honeydew, 2040. Tel: 678-5311/2/3.

8707 – 070 on Service Card



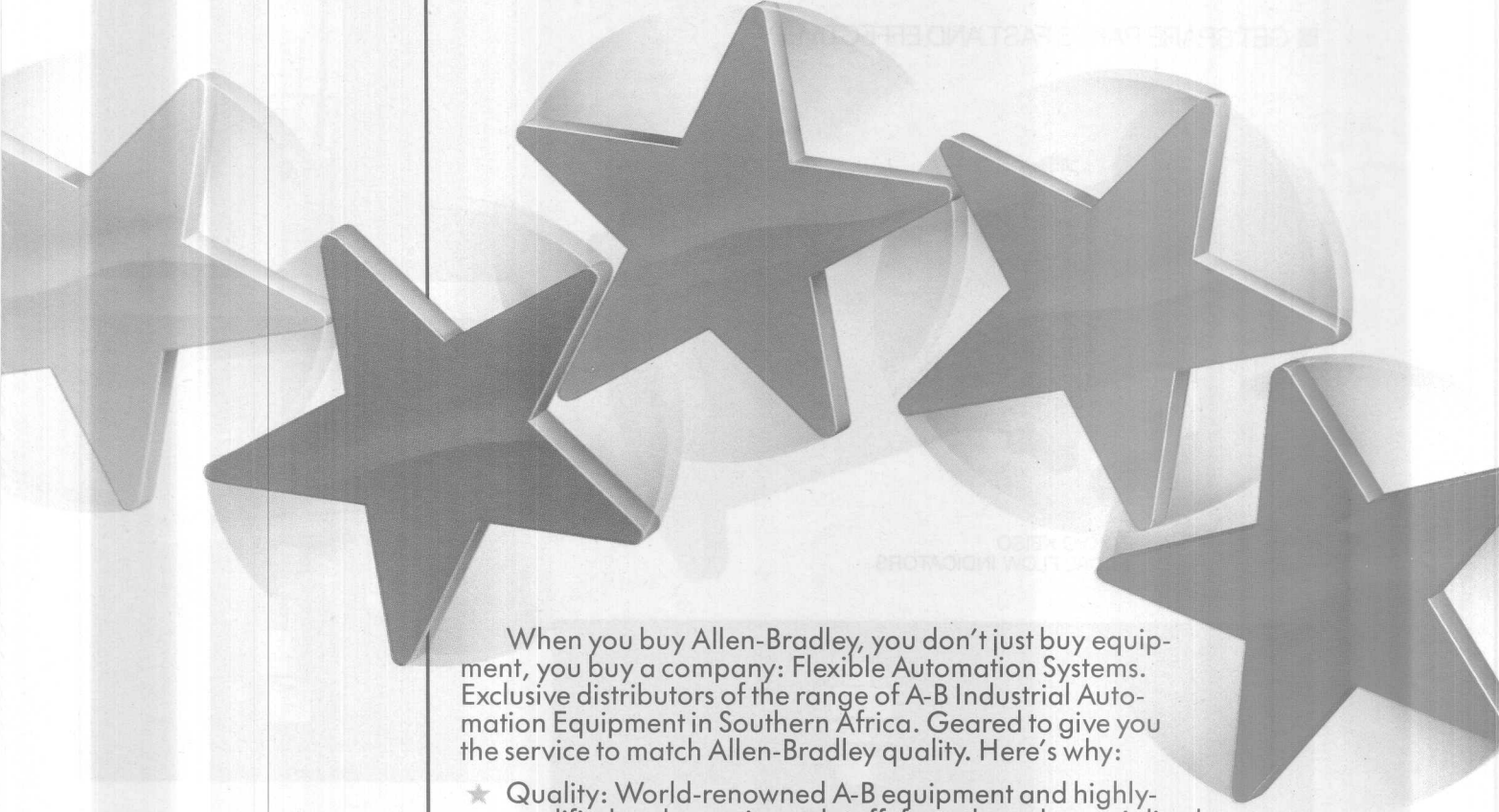
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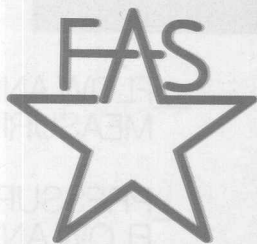


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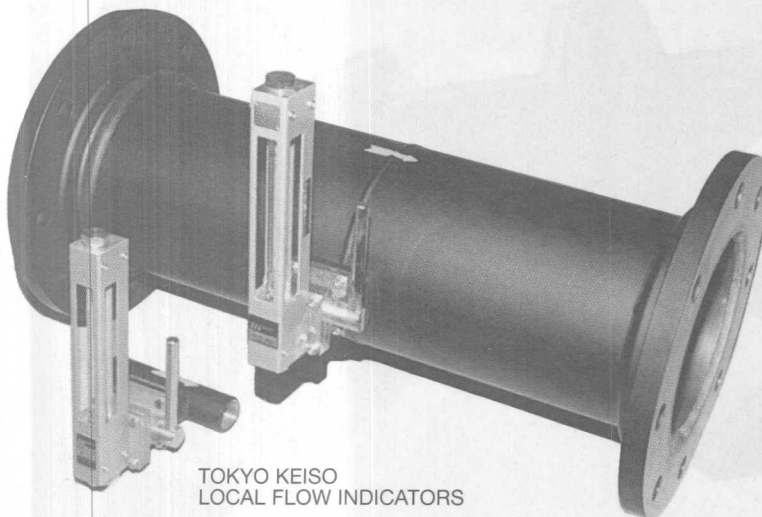
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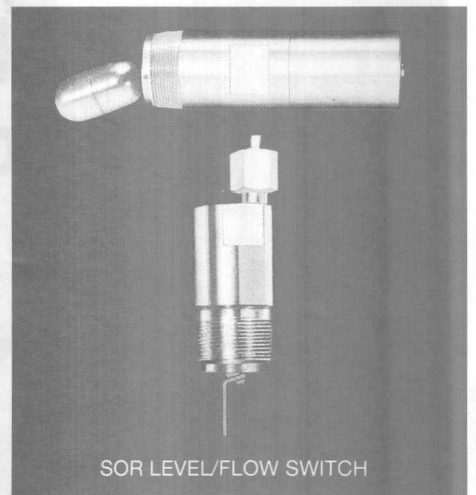
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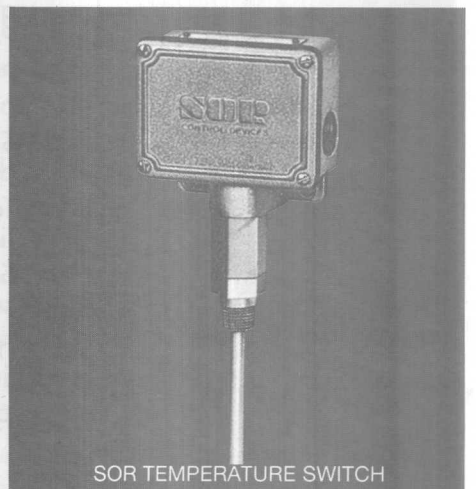
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Automatic component securing machine: brochure from *Blundell* describes their Vacuclamp vacuum forming process used in production processes.

IC Electronics 8707 - 501 on Service Card

PCB insertion aid: data sheet describes the *Blundell* Micro-Grid search eliminator which identifies component insertion positions.

IC Electronics 8707 - 502 on Service Card

Telephone interconnect devices: 52 page catalogue, 'TM' modular connectors from *Hirose* describes their range of jacks, plugs, cord sets, modular blocks, base plates, and speciality connectors.

Crest Components 8707 - 503 on Service Card

Optical fibre connectors: 16 page brochure from *Hirose*.

Crest Components 8707 - 504 on Service Card

Rectangular connectors: 168-page catalogue and guide to the *Hirose* range.

Crest Components 8707 - 505 on Service Card

Circular connectors: 140-page guide to the *Hirose* range.

Crest Components 8707 - 506 on Service Card

Industrial gauging and control: brochure covers the FAG range of nucleonic gauging equipment for basic weight and thickness, coating control, impregnation control, moisture, and density gauging.

I Data Electronics 8707 - 507 on Service Card

Zener diode reference guide: 48-page guide to the *Microsemi* range of zeners and related diodes and products. The range encompasses axial and high power zeners up to 5 W, and stud mount zeners from 10 - 50 W. Chip zeners and transient absorption zeners are also included.

Crest Components 8707 - 508 on Service Card

Hazardous areas: a 56-page guide to the application of BASEEFA approved termination apparatus in hazardous areas, written by R. Martin of *Klippon Electricals*.

Klippon 8707 - 509 on Service Card

Tachometers-generators: data sheet describes the *Sycon Weston* range of a.c. and d.c. devices.

Hurbarn Electronics 8707 - 510 on Service Card

Motion and position indicators: a summary catalogue from *Humphrey* describes their range of gyroscopes, vertical indicators, north seekers, position transducers, accelerometers, pendulums, rates sensors, etc.

Hurbarn Electronics 8707 - 511 on Service Card

Power supplies: complete guide to the *AEG Intermas* range of plug-in modular power supplies designed for 19" racking.

AEG 8707 - 512 on Service Card

Transient suppressors: 28-page guide to the *Fuji* range of metal oxide varistors.

SCD 8707 - 513 on Service Card

Multilayer ceramic capacitors: short form catalogue from *Mira-mar*.

SCD 8707 - 514 on Service Card

200 MHz FIFO buffer: reprint from *AMD* describes their 200 MHz video FIFO buffer which is claimed to be the first to combine a FIFO buffer, an assembly ALU, and a fast shift register.

SCD 8707 - 515 on Service Card

VMEbus packaging system: a 24-page full colour brochure describes the range of *Schroff* products.

PASCO Electronics 8707 - 516 on Service Card

Encoders: *Baumer Electric's* 16-page brochure describes in detail, incremental and absolute encoders, photoelectric fork sensors and a range of accessories.

Temperature Controls 8707 - 517 on Service Card

Precision switches: *Baumer Electric's* 4-page gatefold describes the My-Com measuring and control switches.

Temperature Controls 8707 - 518 on Service Card

Socket adapters: *Precicontact's* 28-page catalogue describes dual-in-line, single-in-line solder and wire wrap strip adapters, dual-in-line and single-in-line sockets for special PC board mounting, plugs and sockets for PC board interconnections.

Procom Aerial 8707 - 519 on Service Card

Toolkits and cases: short form catalogue from *Christensen* describes their full range of toolkits and cases.

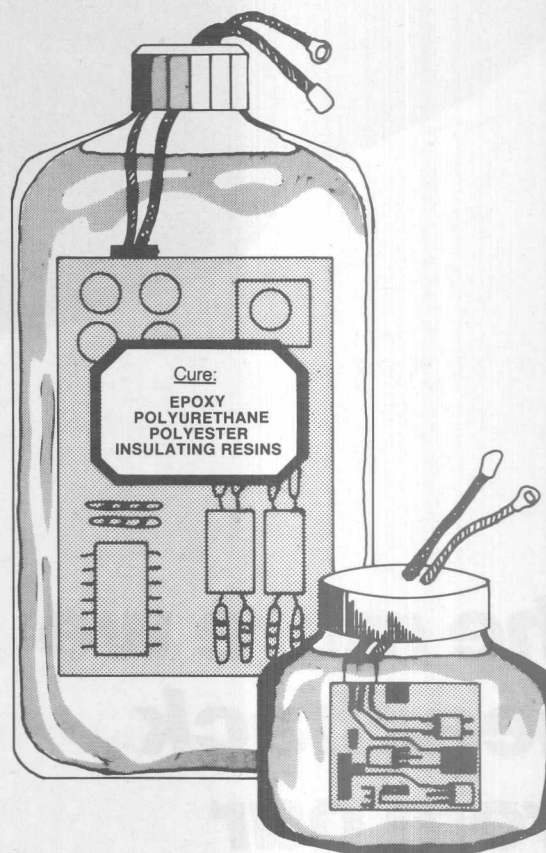
Christensen 8707 - 520 on Service Card

Connector guide: brochure covers the full range of *JAE* products including circular, rectangular, PCB, IDC, high temperature, and waterproof.

U-Tech 8707 - 521 on Service Card

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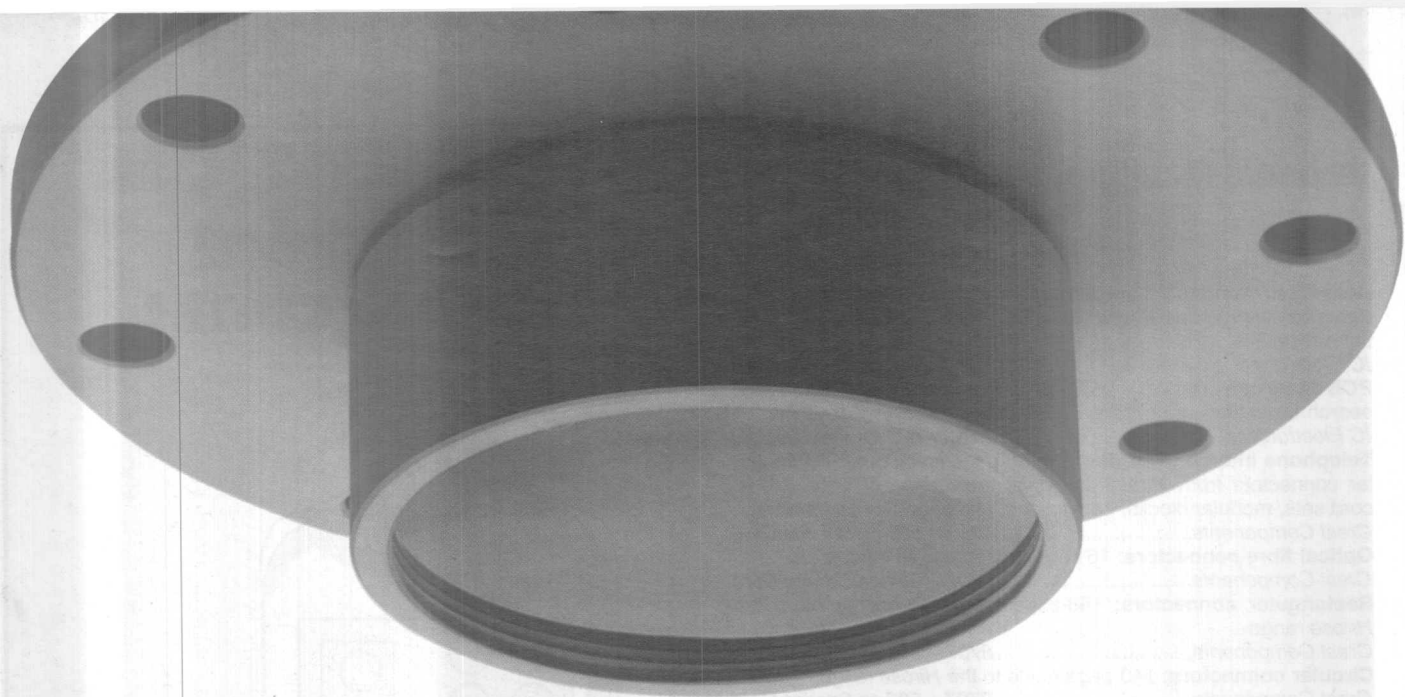
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8707 - 073 on Service Card



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8707 – 074 on Service Card

IEEE-488 bus interface solutions: 1987 catalogue from *National Instruments* contains information about the IEEE-488 bus interface (GPIB) products available for all the major computer architectures and bus structures. The 24-page catalogue features GPIB products for IBM PC, XT, AT, RT and compatibles; for computers from Apple, AT&T, Tandy, Texas Instruments, Apollo, Sun, Compaq, Motorola, and NCR; and for DEC Q-Bus and Unibus, VMEbus, Multibus, S-100 Bus, Std Bus, and SBX Bus. Information about bus extenders, converters and testers is also included.

National Instruments' newest product lines are described in the catalogue including a family of intelligent interfaces that support the AT&T 3B2 computers and the Texas Instruments Explorer workstations.

The newest product described is LabVIEW (Laboratory Virtual Instrument Engineering Workbench) – a scientific software system that runs on the Apple Macintosh. LabVIEW uses interactive graphics and a graphical programming language to provide an integrated environment for applications involving instrument control, data acquisition, data analysis, data display, data management, and report generation.

The catalogue includes details on GPIB interface boards and on the comprehensive operating system and language support available.

Westplex Computer Systems 8707 – 522 on Service Card

Wire preparation: four-page, colour brochure describing *Ideal Industries'* new state-of-the-art Wire Prepper System I. The Wire Prepper is an automatic, microprocessor-controlled device that accurately measures, cuts and counts wire and tubing at a rate of up to 880 m/h in lengths varying from 2.5 mm to 25 m. The brochure details product features and specifications, typical productivity rates, optional equipment and ordering information.

BHD 8707 – 523 on Service Card

Solder and fluxes: short form catalogue from *Multicore* includes condensed information on fluxes and chemicals, solder wires, low-residue cored wire, solder preforms and solder tape, solder ingots, bars, sticks and pellets. There is also information on the solderability tester and Vaporette vapour-phase solder-reflow system.

IC Electronics 8707 – 524 on Service Card

Bus controller and RTUs: latest full line catalogues and 'total capability' brochures are freely available from *ILC-DDC*, suppliers of bus controllers, protocol, dumb RTUs, transceivers, test equipment, transformers, and remote terminals.

Urardu 8707 – 525 on Service Card

Wafer level trim of monolithic D/A converter: a new four-page application note from *ILC Data Device Corporation*, written by Barry Dorobkowski.

The application note discusses in detail the consideration that must be taken into account when trimming a monolithic chip that contains most of the active components of a D/A converter. A detailed analysis is presented on vapox, laser, mechanical, resistor trimming, and fixturing wafer considerations as well as the required software organisation.

The author concludes that, though wafer level trimming of monolithic devices is a complex process, it is not very difficult to maintain high device yields once an understanding of the various factors is obtained. The versatility afforded by a well designed monolithic digital-to-analog converter allows it to be used as a building block in a variety of linear hybrid circuit designs, enhancing the performance and reliability of each design in which it is used.

Urardu 8707 – 526 on Service Card

Pliers and tweezer: brochure from *CK* describes their range of specialised tools for the electronics industry.

Christensen 8707 – 527 on Service Card

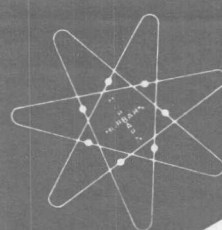
Multifunction PLCs: catalogue describes the *Telemecanique* TSX67 and TSX87 range.

Telemecanique 8707 – 528 on Service Card

1553 designers guide: since its introduction four years ago, *DDC's* MIL-STS-1553 'Designer's Guide' has gained recognition as a valuable tutorial on the subject. Requests for copies have not diminished and *DDC* is happy to announce availability of the book's fourth printing. The Designer's Guide was prepared to explore the 1553 standard with some thoroughness as an aid to the design engineer confronted with a 1553 interface requirement.

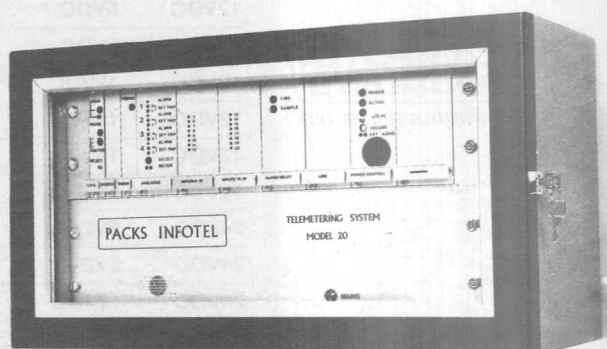
It contains an overview of the standard, a comparison of several variations of the standard and a discussion of system hardware and software considerations. A complete copy of MIL-Std-1553B is included with a running paragraph-by-paragraph commentary on the whys and wherefores of the actual standard and a direct comparison with the earlier version A.

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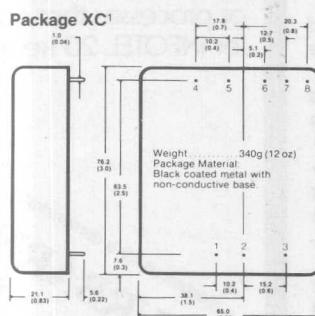
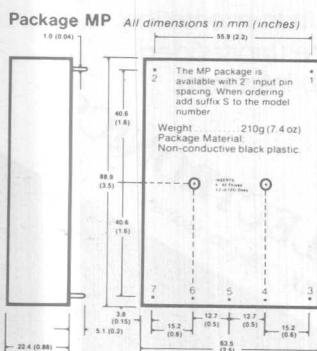


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Input Voltage Range

Nominal	Input Range
12VDC	9-18VDC
24VDC	18-36VDC
48VDC	36-72VDC

Dimensions

XC 76.2 x 65 x 21.1 mm	3.0 x 2.56 x 0.83 In.
MP 88.9 x 63.5 x 22.4 mm	3.5 x 2.5 x 0.88 In.

Input Voltage	Output Voltage	Output Current	Line Regulation	Load Regulation	% Efficiency	Case	Model Number
12VDC	5VDC	3000 mA	±0.2%	±1%	75	XC	WR12S05/3000XC
12VDC	5VDC	3000 mA	±0.2%	±1%	75	MP	WR12S05/3000MP
12VDC	12VDC	1250 mA	±0.2%	±1%	78	XC	WR12S12/1250XC
12VDC	12VDC	1250 mA	±0.2%	±1%	78	MP	WR12S12/1250MP
12VDC	15VDC	1000 mA	±0.2%	±1%	78	XC	WR12S15/1000XC
12VDC	15VDC	1000 mA	±0.2%	±1%	78	MP	WR12S15/1000MP
24VDC	5VDC	3000 mA	±0.2%	±1%	77	XC	WR24S05/3000XC
24VDC	5VDC	3000 mA	±0.2%	±1%	77	MP	WR24S05/3000MP
24VDC	12VDC	1250 mA	±0.2%	±1%	80	XC	WR24S12/1250XC
24VDC	12VDC	1250 mA	±0.2%	±1%	80	MP	WR24S12/1250MP
24VDC	15VDC	1000 mA	±0.2%	±1%	80	XC	WR24S15/1000XC
24VDC	15VDC	1000 mA	±0.2%	±1%	80	MP	WR24S15/1000MP
48VDC	5VDC	3000 mA	±0.2%	±1%	77	XC	WR48S05/3000XC
48VDC	5VDC	3000 mA	±0.2%	±1%	77	MP	WR48S05/3000MP
48VDC	12VDC	1250 mA	±0.2%	±1%	80	XC	WR48S12/1250XC
48VDC	12VDC	1250 mA	±0.2%	±1%	80	MP	WR48S12/1250MP
48VDC	15VDC	1000 mA	±0.2%	±1%	80	XC	WR48S15/1000XC
48VDC	15VDC	1000 mA	±0.2%	±1%	80	MP	WR48S15/1000MP
12VDC	±12VDC	±625 mA	±0.2%	±1%	82	XC	WR12D12/625XC
12VDC	±15VDC	±500 mA	±0.2%	±1%	82	XC	WR12D15/500XC
12VDC	±12VDC	±625 mA	±0.2%	±1%	82	MP	WR12D12/625MP
12VDC	±15VDC	±500 mA	±0.2%	±1%	82	MP	WR12D15/500MP
24VDC	±12VDC	±625 mA	±0.2%	±1%	84	XC	WR24D12/625XC
24VDC	±15VDC	±500 mA	±0.2%	±1%	84	XC	WR24D15/500XC
24VDC	±12VDC	±625 mA	±0.2%	±1%	84	MP	WR24D12/625MP
24VDC	±15VDC	±500 mA	±0.2%	±1%	84	MP	WR24D15/500MP
48VDC	±12VDC	±625 mA	±0.2%	±1%	86	XC	WR48D12/625XC
48VDC	±15VDC	±500 mA	±0.2%	±1%	86	XC	WR48D15/500XC
48VDC	±12VDC	±625 mA	±0.2%	±1%	86	MP	WR48D12/625MP
48VDC	±15VDC	±500 mA	±0.2%	±1%	86	MP	WR48D15/500MP

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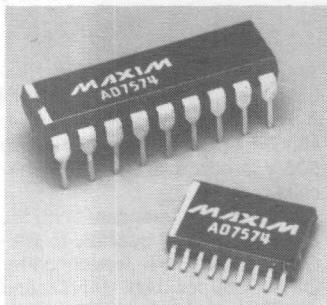
8707 - 076 on Service Card

8-bit ADC in SM

Maxim's direct replacement for the AD7574 CMOS μ P-compatible 8-Bit A/D converter is claimed to be the first available in the surface-mounted SO (small-outline) plastic package, in addition to standard cerdip, plastic and side-braze ceramic DIPs.

The AD7574 uses the successive-approximation technique to achieve a 15 μ s max. conversion time. The design provides easy interfacing with microprocessors by appearing as a memory location or I/O port. Data outputs use latched, three-state buffers allowing direct connection to the microprocessor databus or system input port. The AD7574 contains an on-board clock, operates from a single +5 V supply, and features low power consumption of 25mW max.

Two electrical grades are available that guarantee maximum differential nonlinearity at $\pm 7/8$ LSB or $\pm 3/4$ LSB, J, A, and S, or K, B, and T suffixes respectively.



tively. The J and K grades are specified over the Commercial temperature range (0 °C to 70 °C), A and B grades over the Industrial temperature range (-25 °C to +85 °C), and the S and T grades over the Military temperature range (-55 °C to +125 °C).

Packaging for Commercial devices is either the 18-pin plastic DIP or SO. Industrial and Military devices are packaged in cerdip or sidebrazed ceramic DIP.

SCD 8707 - 077 on Service Card

Edge-emitting LED

The Fujitsu FED130M2BF is a highly reliable, fast response, InGaAsP/InP double heterostructure edge-emitting LED, coupled to a single mode fibre in a 14-pin DIL package.

This module has low operating

current and a stable optical output power over a wide temperature range and is specially suited for applications in medium-bit-rate optical transmission systems in the 1.3 μ m wavelength.

Urardu 8707 - 078 on Service Card

High-speed A/D converter

Datel's ADC-974 utilises a two-pass architecture in accomplishing a 16-bit A/D conversion in just 2.5 μ s. Linearity is guaranteed to $\pm 1/2$ LSB to 14 bits.

The ADC-974 accepts analog inputs over a ± 5 V range and completes a full conversion in 2.5 μ s maximum including all set-up, settling and delay times. The conversion result is coded as Complementary Two's Complement and is latched into TTL compatible outputs.

The ADC-974 features $\pm 1/2$ LSB maximum differential linearity to 14 bits, offset drift of only ± 1 LSB at 14 bits over the rated operating temperature range and a reference output tempco of ± 5 ppm/°C.

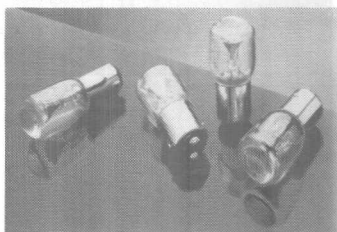
The converter is packaged in a 150 x 100 x 9.5 mm black enamelled steel module. A 34-pin AMP connector mounted at one end supplies all interconnect points without extending case size. Each module is functionally complete requiring only ± 15 V d.c. and +5 V d.c. supplies for operation, and has an operating temperature range of 0 to 70 °C.

EBE

8707 - 079 on Service Card

High light neons

An energy-efficient, long life gas-discharge lamp, for use in electronic displays and message centres, from IEE, consumes only 2 W but has a light output of over 15 000 cd/m² (measured on axis). The bright, neon-orange light can be read in direct sunlight, making it ideal in such applications as scoreboards and freeway message displays. Displays of virtually any size can be created when the lamps are installed in bayonet sockets mounted on 25 mm centres.



In addition the lamps have a rated life of 20 000 h at which time light output will have fallen to approximately half of original brightness.

Gas-discharge lamps require 155 V d.c. 13 mA each for operation.

Inmass

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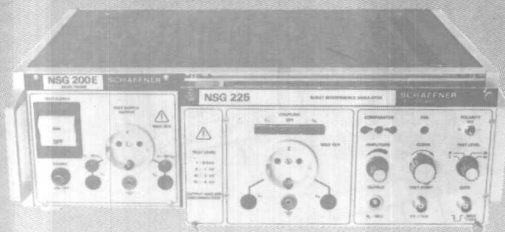
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components

Power MOSFETS

A line of military qualified power MOSFETS rated from 100 to 500 V is now available from Fairchild.

The industry-standard 2N6756, 2N6758, 2N6760 qualified to MIL-S-19500/542 are listed under QPL-19500 for JAN, JANTX and JANTXV levels of reliability while 2N6768 and 2N6770, qualified to

MIL-S-19500/543B are listed under QPL-19500 for JANTX and JANTXV levels.

Fairchild's military power MOSFETS are immediately available in TO-204AA (formerly TO 3) metal packages and have an operating temperature range of -55 to 150°C .

Fairmont

8707 – 086 on Service Card

Germanium avalanche photodiode

The Fujitsu FPD13R12TU is a germanium avalanche photodiode designed to be used in local area network systems and short distance data links. The photosensitive area is $100\ \mu\text{m}$ in diameter and a TO-18 type hermetic package, with integral lens in the cap, enables easy and effective coupling from a fibre.

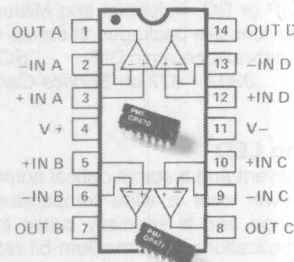
Other features include: wide spectral response range, 800 to $1520\ \text{nm}$; high cutoff frequency, 1 GHz; low operating voltage, 30 V; and low dark current, $0,3\ \mu\text{A}$.

Urdu Electronics

8707 – 087 on Service Card

Low noise, precision quad op-amp

PMI's OP-470 is a precision quad operational amplifier with exceptionally low voltage noise, only $5\ \text{nV}/\text{Hz}$ at 1 kHz max, offering comparable performance to PMI's industry standard (single) OP-27.



The quad OP-470 features an input offset voltage of $400\ \mu\text{V}$ maximum, eliminating the need for offset trimming. Input offset drift is less than $2\ \mu\text{V}/^{\circ}\text{C}$ over the military and industrial temperature ranges.

Other features include: open-loop gain of over 1 000 000; input bias current under 25 nA; common-mode rejection of 110 dB minimum, and power supply rejection of 115 dB minimum; and unity gain stable with a gain-bandwidth product of 6 MHz and a slew rate of $2\ \text{V}/\mu\text{S}$.

Allied Electronic Components

8707 – 084 on Service Card

Isolated bandpass filter

K & L Microwave's isolated bandpass filter, 19FV-14250/500-0/0, is a bandpass filter with a centre frequency of $14,25\ \text{GHz}$ and a bandwidth of 500 MHz. The 'I' designates the presence of isolators at both the input and output connectors. These isolators provide typically 18-20 dB of isolation although other isolators are applicable. Specifications for this model are:

- ☐ VSWR over the entire pass-band is $< 1,3:1$ maximum;
- ☐ insertion loss at centre frequency is $< 2,0\ \text{dB}$ maximum;
- ☐ passband ripple of $\pm 0,25\ \text{dB}$ maximum in the 14-14,5 GHz range; and
- ☐ stopbands of 50 dB minimum at 15-30 GHz, and 80 dB minimum at d.c.-13,4 GHz.

Urdu Electronics

8707 – 085 on Service Card

Buffer amplifier for electret microphones

With telephone handsets increasingly using electret microphones instead of the traditional carbon granule, Ferranti has developed a single component buffer amplifier, the ZN482Z, which matches the electret's high impedance with the speech amplifier's low impedance input. It achieves this translation with minimal distortion, typically as low as 0,06%.

The ZN482Z maintains excellent performance even when subjected to a leakage path with a resistance as low as $40\ \text{M}\Omega$. At this level the gain loss between input and negative supply this falls to only 0,4 dB.

The device is packaged in TO92 and is both electrically and pin compatible with the PBL 3747.

Liberty Electronics

8707 – 088 on Service Card

Quad 8-bit CMOS DAC

PMI's PM-7226 is a quad 8-bit voltage output, multiplying CMOS DAC which contains four 8-bit DACs with output buffer amplifiers, R/2R resistor ladder networks, input data latches, and interface control logic for all DACs.

Requiring no user adjustment, the PM-7226 features a total unadjusted error spec of $\pm 1/2\ \text{LSB}$, a zero code error of 5 mV, a differential nonlinearity of $\pm 1/2\ \text{LSB}$, a fast 90 ns write pulse time, and a low temperature-coefficient, typically $10\ \mu\text{V}/^{\circ}\text{C}$.

Allied Electronic Components

8707 – 089 on Service Card

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If you don't need the scanning and recording features, you may prefer the single-point Fluke 51. Like the 52, it's easy to use, offers unsurpassed accuracy with resolution to 1/10th of a degree, and can use any K or J type thermocouple probe to fit your application.

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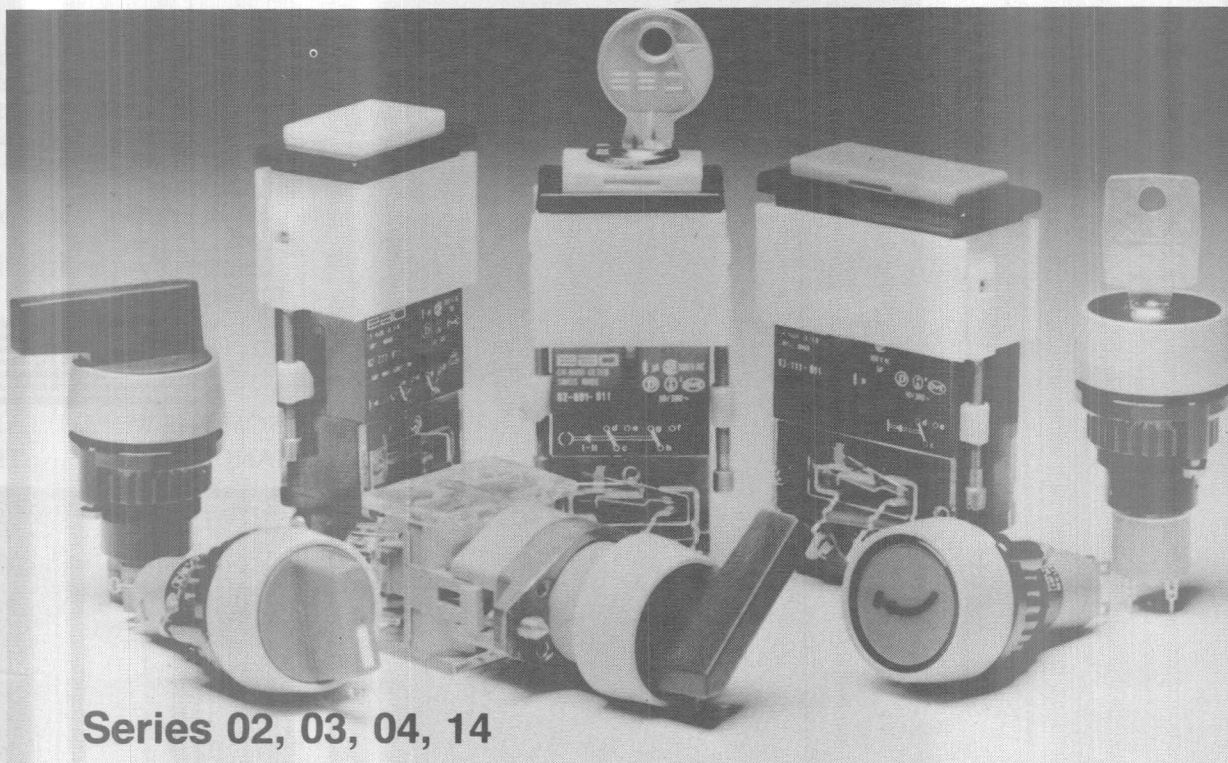
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PULSE/SA MEASUREMENT & CONTROL - July, 1987 71

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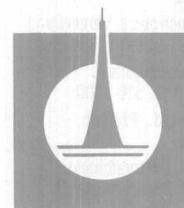
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with up to 4 contact blocks snap mounted. Slow make or snap acting switch system with standard hard silver contacts.

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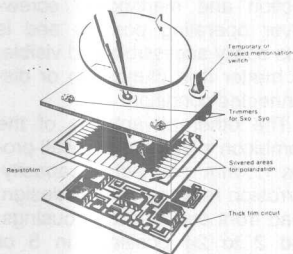


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Reg. No. 69/12589/07

x-y joystick manipulator

Sfernice has patented an electronic x-y manipulator or joystick. Conventional types usually have two potentiometers coupled by a mechanical device but Sfernice's joystick uses a conductive plastic sheet which is polarised alternately according to the x and y axes. The (x-y) positions are given by a spring-loaded point wiper, connected to the stick. The x-y values are read 1000 times per second to reduce distortion and a memory freezes a pair of values either permanently or temporarily so that the system can indicate the position of the stick at any time. Local agent for Sfernice is ECS, a member of the United Technologies Group.



The joystick system is cleared 0 to 70 °C operation and optionally available for -55 to 125 °C. Other optional features are: dual scale, memorisation of coordinates, voltage supply from 20 V to 48 V, and eight bit digital output.

ECS

8707 - 092 on Service Card

Slim-line fans



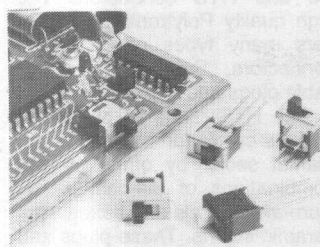
The new range of Papst Slim-line a.c. fans is only 25 mm thick and is available in sizes of 80 x 80, 92 x 92, and 119 x 119 mm in voltage ratings of 115, 220 and 240 V, with each model available in two speeds. Other features include:

- shaded pole motor with internal rotor;
- metal housing;
- impeller of glassfibre reinforced polycarbonate;
- high precision ball bearings;
- permissible temperature range -30 to 70 °C; and
- safety approvals by UL and CSA, with VDE approval pending.

Retron

8707 - 093 on Service Card

Miniature slide switches



The C&K Components Inc TS series tiny slide switch, feature miniature size and DIP pattern compatible terminal spacing.

Features include positive detent actuation and two SPDT switching functions: ON-ON and ON-OFF-ON. Three terminal styles available including PC, wirewrap, and right-angle. Epoxy terminal sealing also available. Ratings from dry circuit (with gold plated contacts) to up to 3 A at 120 V a.c. or 28 V d.c. (with silver plate contacts). Contact resistance: below 20 mΩ typ. initial. Insulation resistance: 10⁹ Ω min. Dielectric strength: 1000 V rms min at sea level. Case material is DAP. Actuator is black nylon. Housing material is stainless steel.

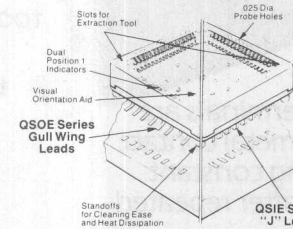
Suntronika

8707 - 094 on Service Card

SM chip carrier socket

Burndy's new surface mount chip carrier socket enables those OEMs using surface mount techniques to also enjoy the advantages of package pluggability which socketing provides. Designed with both input and output leads on 1,27 mm centres, this Burndy socket is intended to accommodate JEDEC plastic chip carriers.

The unique, low profile body has been moulded in heat resistant thermoplastic to withstand the temperatures encountered in surface soldering. Solder leads, formed of beryllium copper, are available in either gull wing or "J" designs and are plated with a special tin alloy to further enable the socket to withstand the rigours of surface mounting.

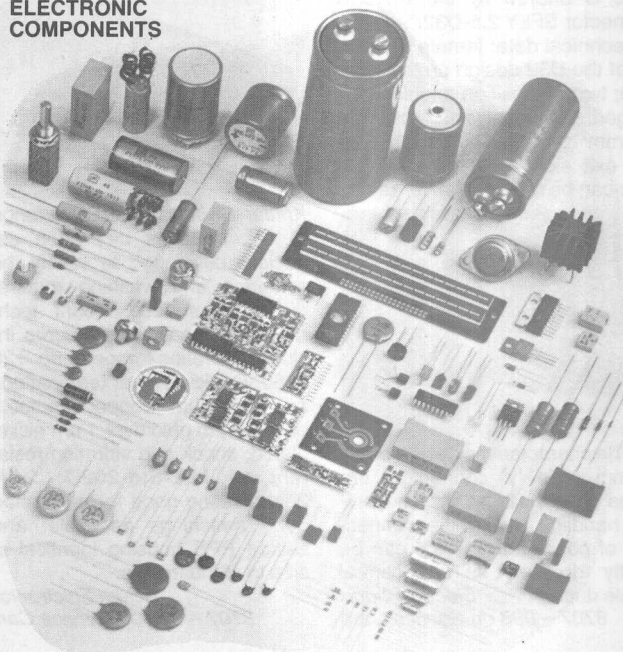


The new socket is intended to deliver consistent performance over a continuous operating temperature from -40 to 85 °C.

Connecta

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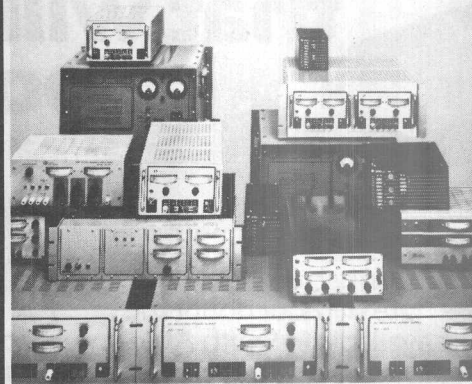


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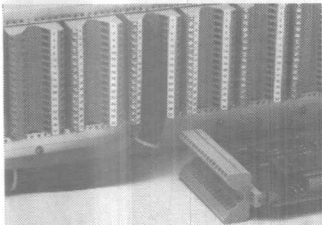
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8707 - 097 on Service Card

'y' connectors

A new solution to the problem of transitions from DIN 41612 female connectors to field wiring connections is offered by the *Phoenix* connector SFLY 2,5-D32.

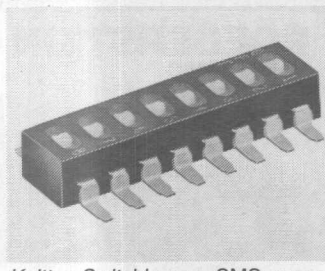
Technical data: female connector of the D32 design on the entry side; two 16 position angularly arranged screw terminal rows for 2,5 mm² stranded conductors on the exit side; and the complete strip can be mounted in 19" racks.



The characteristic design of the 40 mm wide 'y' connectors ensures good visibility and convenient handling during the connection of conductors, which can be neatly dressed in the central 'cable duct'.

Electro-Phoenix
8707 - 098 on Service Card

Surface mount DIL switches



Knitter Switch's new SMS range of DIL switches has been especially developed to satisfy the soldering and washing requirements of surface mount technology applications. Features include: operating temperature -20 to 80 °C; nickel silver terminations and beryllium copper contacts both 0,3 µm gold over 1 µm nickel plated; shock and vibration resistant to MIL-Std-202D; 24 V 25 mA rating good for more than 5000 switchings per pole; and sealed PPS housing identical in size to standard ICs.

Actum Electronics
8707 - 099 on Service Card

Battery holders

The *Bulgin* range of battery holders is designed to accommodate AAA, AA, C, D, or PP3 cells. Circuit designers can select from baseboard, PCB or panel mounting arrangements.

Interlocking PCB and baseboard battery holders can be provided for the range so that multiple assemblies can be built up. Dual

solder tag and PCB pins are provided, and polarity is clearly marked.

Multiple cells can be held in the circular panel mounting units, secured by a screw-cap. Single hole fixing is from the front of the panel with rear lock nut.

IC Electronics
8707 - 100 on Service Card

components

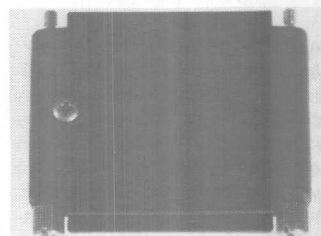
Interconnection technology

Klippon's product range has been expanded to include the 'Polytronic' and 'HTS' connectors. The high quality Polytronic range covers many types of PC board connectors, Sub-D and ribbon cable plugs and sockets.

The HTS range of plugs and sockets caters for the heavy-duty market sector by offering many combinations of die-cast aluminium-alloy hoods and bases, with ceramic inserts. These plugs and sockets are available with from 6 to 64 pins, and are used typically by power stations, the machine-tool industry, and other heavy-duty current applications.

Klippon SA
8707 - 101 on Service Card

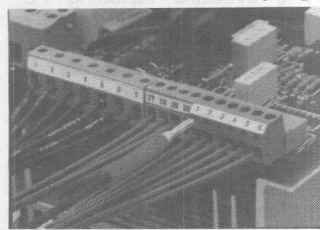
D-subminiature adaptor



The new *Conec* series CDA D-subminiature adaptor is a two-piece hood for quick and easy mounting of male/female or other adaptors. Made of black nylon, mounting is achieved by two jackscrews with UN4-40 internal and external threads.

Actum Electronics
8707 - 102 on Service Card

'Combicon' plug with test connection



An added test socket is offered by the new *Phoenix Contact* Combicon plug.

The test socket is conveniently located between conductor con-

nection and marking or screw-driver operating position and is thus easily accessible and visible, no matter if in plugged-in or disconnected condition.

The other advantages of the Combicon plug remain: well-proven 1,5 mm² connection capacity; corrosion resistant overall design; dead front construction housings; and 2 to 24 positions in 5 or 5,08 mm spacing.

Electro-Phoenix
8707 - 103 on Service Card

CONNECTORS

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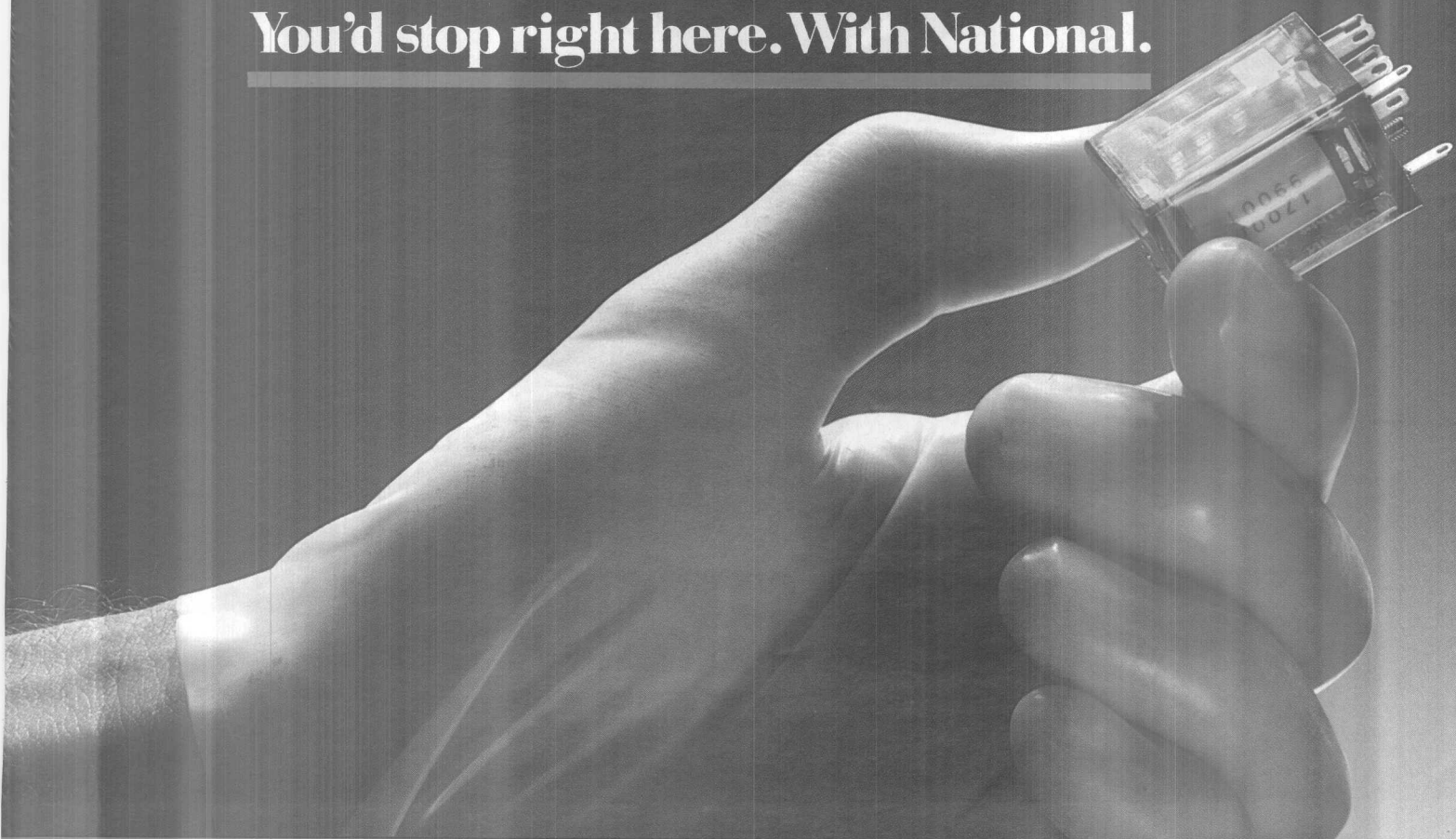
National relays are also highly efficient. Designed to meet the growing need to reduce energy and costs, in the electronic age of today and tomorrow.

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National
The quest for zero defect

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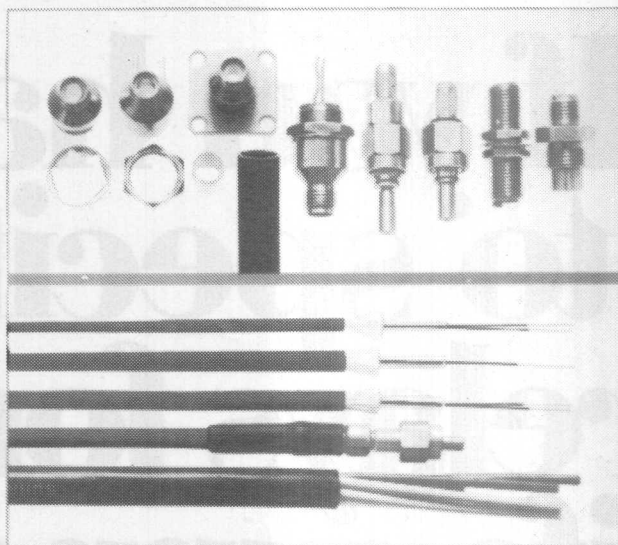
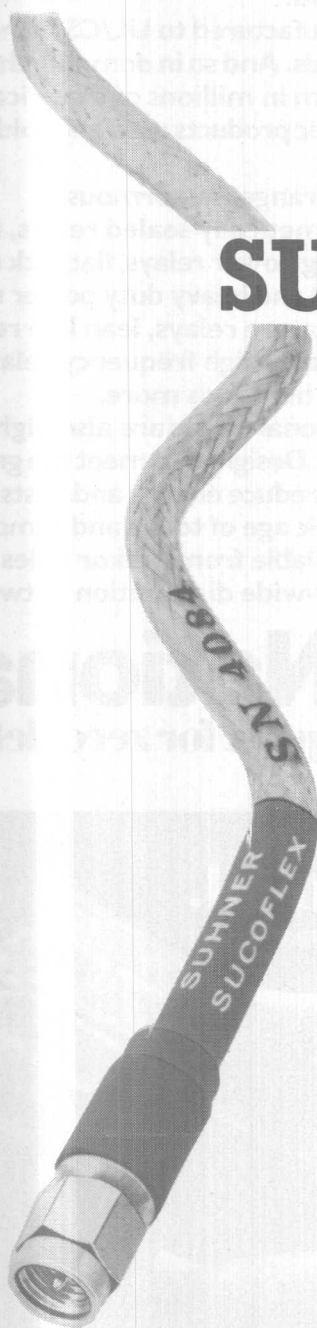


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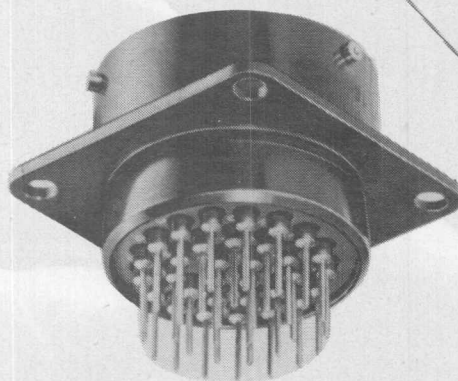
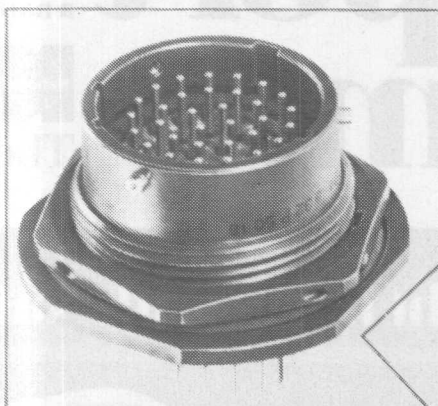
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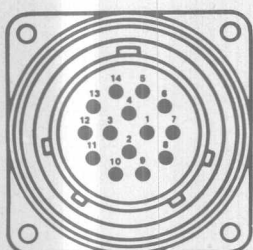


CABLES



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CONNECTORS

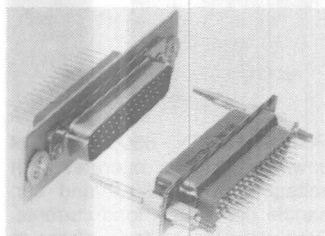


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'Blindmate-D' guide system for subminiature-D connectors



Positronic now offers a 'Blindmate' Guide System for use with Subminiature-D connectors in which the mounting flange of the free connectors align themselves with the floating panel islets of the fixed or panel mounted connectors. This assures easy coupling of the connector, preventing damage to contacts through misalignment, thereby assuring circuit integrity during 500 operations.

Retron

8707 - 107 on Service Card

Low cost D-subminiature connector

TRW has introduced low cost D-subminiature connectors in a new range known as the Extra-D series.

Many applications for D-subminiature connectors do not require a heavy gold plate finish as necessary for military and telecommunications. Most industrial applications will be adequately fulfilled by this new connector which has gold plated contacts in a polyester moulding with zinc or tin plated steel shells.

The connectors will operate at temperatures between -55 to 125°C and will carry a current of up to 5 A per contact at working voltages up to 300 V.

The contact design has special features which prevent solder passing from the solder bucket to the contact surface during the wiring operation. A full range of hoods and mounting brackets is available to support this range of connectors.

Electrolink

8707 - 108 on Service Card

Silicone elastomers

Boron-Nitride-filled silicone elastomers from Chomerics, reinforced with fibreglass, provide the highest thermal and electrical performance in component interface materials for electronic packaging applications, and are intended to replace the two-component greased beryllium oxide systems.

Cho-Therm 1671 has very high voltage breakdown and 1678 meets the need for moderate dielectric performance. 1671 and 1678 are not susceptible to cracking when torqued between parts with surface irregularities. They are greaseless and there is no migration, contamination or drying-out.

ECS

8707 - 109 on Service Card

CPA solderable heatsinks

One-piece solder tag heatsinks that can be conveniently and economically attached to the host PCB by the same solder process as for other PCB components have been developed by Redpoint.

Manufactured from a new material, copper plated aluminium (CPA) strip, the TV905 is formed in one press blow eliminating the need for a costly separate tagging operation. The new heatsink retains the low weight and price of aluminium, but has the same soldering properties as copper.

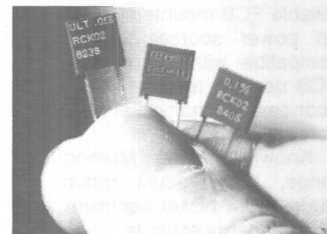
Liberty Electronics

8707 - 110 on Service Card

Precision resistors

Sfernice has approval by European Space Agency of the Ni-crocer foil ultra-precision resistor range designated RCK02 (RNC90Y). This resistor range was the first to qualify for European CECC approval and also has full US Military qualification to MIL-R-55182/9.

The characteristics for ESA applications are: range $33\ \Omega$ to $100\ \text{k}\Omega$, tolerance $\pm 0.02\%$ to $\pm 1\%$, temperature coefficient $< \pm 5\ \text{ppm}/^{\circ}\text{C}$, temperature range

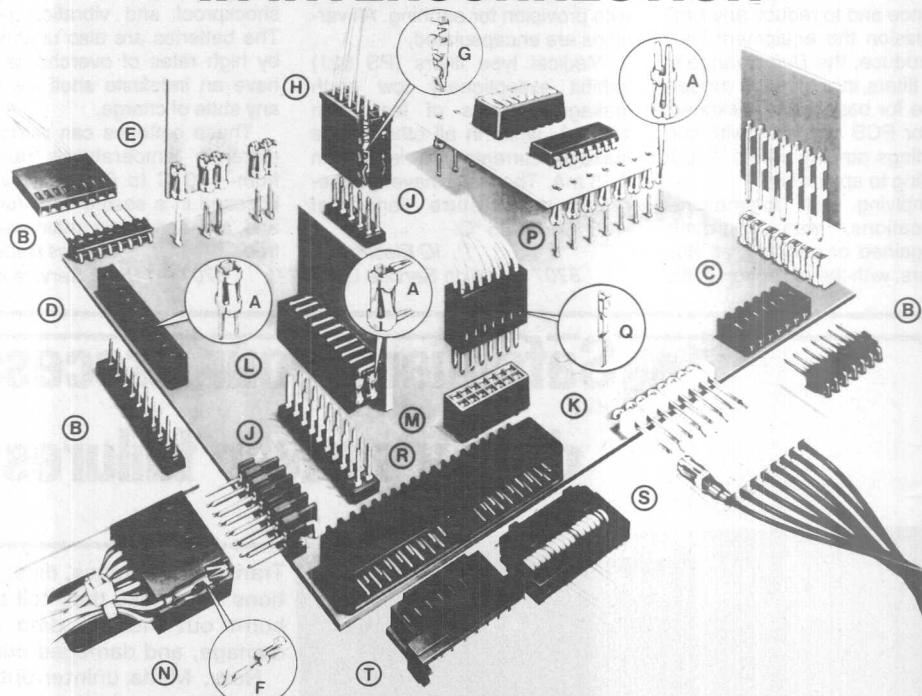


-55° to $+125^{\circ}\text{C}$, and power $0.5\ \text{W}$ at $+70^{\circ}\text{C}$.

ECS

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AMPMODU receptacles for 025 [0,64] Sq. or round posts

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C Horizontal Board Mounted Receptacle Assemblies, Single Row

D Vertical Board Mounted Receptacle Assemblies, Single Row

E Wire Applied Contact Housings, Single Row

F Crimp Snap-In Receptacle Contacts in standard, intermediate and high pressure versions

G Locking Clip Contacts, Crimp Snap-in

H Locking Clip Housings, Single and Double Row

J Unshrouded Straight and Right Angle Post Header Assemblies, Double Row

K Shrouded Straight and Right Angle Post Header Assemblies, Single and Double Row

L Horizontal Board Mounted Receptacle Assemblies, Double Row

M Vertical Board Mounted Receptacle Assemblies, Double Row

N Wire Applied Contact (Receptacle) Housings, Double Row

P Wire Applied Contact (Pin) Housings - same as wire applied contact housings (E,N), except used with crimp snap-in pin contacts

Q Crimp Snap-in Pin Contacts - available for $0.12-0.4\text{mm}^2$ wire size range for use in all wire applied housings

S AMP-LATCH Receptacle Connectors AMP Catalogue No. 80-4058

T AMP Products for Flexible Flat Conductor Wiring AMP Catalogue No. 81-151

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8707 - 112 on Service Card

Memory preservation energy systems

Soft memory preservation energy systems which provide a comprehensive solution to the problem of reliable PCB-mounted RAM back-up power sources, are totally compatible with micro-electronics PCB designs and are the key to economical 'non-volatile' RAM data retention.

Known as the Memoguard range, this product group includes both nickel cadmium and lithium energy sources.

The Memoguard 'R' nickel cadmium series includes about 16 different types of rechargeable batteries with from 2 to 6 cells and rated capacities from 40 mAh to 220 mAh.

The Soft lithium range is non-rechargeable and features an ex-

tremely low discharge rate. This range includes the Dataguard LD primary series which is a PCB mountable range of non-rechargeable energy systems developed to guarantee continuity of power to volatile CMOS RAM devices for up to ten years under mains power failure mode conditions. They are also designed to function in other low drain devices that operate in or above ambient temperatures.

Classified as one of the safest lithium systems, these Dataguard batteries meet the demands for reliability, circuit compatibility and the ability to operate in diverse conditions.

Uniross Batteries

8707 - 113 on Service Card

Mains filters

Designed to protect electronic equipment from mains borne interference and to reduce any similar emission the equipment itself may produce, the Bulgin range of mains filters incorporates models suitable for baseboard, bulkhead, panel or PCB mounting with current ratings ranging from 1 - 10 A according to application.

Complying with international specifications, with approvals either gained or pending, all Bulgin filters, with the exception of the

PCB mounting versions, are enclosed in drawn steel casings, with provision for earthing. All versions are encapsulated.

Medical type filters (PS 621) exhibit exceptionally low earth leakage currents of less than 100 μ A, while in all other cases leakage currents are less than 0.35 mA. The filters have an operating temperature range of -25 °C to +85 °C.

IC Electronics

8707 - 114 on Service Card

Economy RFI power filters

The economy range L1829, L1856 - L1858 of Belling Lee In-tech RFI power line filters provide adequate insertion loss for any situation where protection is not needed against very high or very low frequencies. Typical uses are the protection of industrial machinery and laboratory and bench-test supplies. They provide excellent protection against mains-borne transients.

The filter networks are fully encapsulated in epoxy resin. The high quality corrosion-proof electroplated steel cases have a hammer grey paint finish and a screw-type access cover to the terminations. Designed for 440/250 V d.c. 50/60 Hz, the range covers current ratings of 6, 8, 30 and 100 A.

EMC Technology

8707 - 115 on Service Card

Batteries for emergency lighting

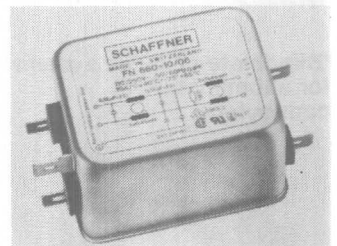
The Saft VT range of high temperature, nickel cadmium batteries is widely used in many emergency lighting installations as it is shockproof and vibration proof. The batteries are also unaffected by high rates of overcharge and have an indefinite shelf life from any state of charge.

These batteries can withstand extreme temperatures ranging from -40 °C to 65 °C. They are encased in a sealed construction and are absolutely maintenance free.

Uniross Batteries

8707 - 116 on Service Card

High attenuation mains filter



Schaffner's FN 660 range of power line filters operates with voltages up to 250 V and can handle up to 16 A load currents. Production test voltage, phase to ground and phase to neutral, is 2 kV/50 Hz, ≥ 2 s. Ambient operating temperature range is -25 °C to +85 °C. Insertion loss varies according to type and is included in the Schaffner brochure.

Robmet

8707 - 117 on Service Card

Fully ruggedized PS

The CPS series of high power fully ruggedized power supplies provide output voltages in the range of 24 - 32 V d.c. at up to 150 A (30 V at 200 A also available).

Features include: high efficiency > 85 %; small size (133 x 482 x 550 mm); lightweight > 28 kg; internal cooling; remote turn-on/turn-off; remote sensing and programming; meters and mode indication lamps; and built-in OVP.

Afitra

8707 - 118 on Service Card

Safeguard your process during power failures



Transients, outages, dips, brownouts, and frequency variations — all take their toll on your process: false triggering, burnt out motors, data corruption, permanent memory damage, and damaged components.

Now, Matla uninterruptible power supply systems can help you:

- genuine no-break automatic load transfer
- high regulation characteristics
- extremely quiet operation
- modular building-block approach over the whole power range of 3 - 150 kVA
- local design and manufacture guarantees service and spares availability.

Facility Planning Services can also offer voltage stabilisers, CVTs, and line conditioners (in the range of 0.15 - 10 kVA) together with static and rotary frequency converters for IBM and AMDAHL.

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The latest in the range is the PP40 series.

The PP40, PP41 and PP42 all stand alone and are designed to provide low-cost, high-speed programming. At one end of

the range the PP40 will solve all copying problems in a single operation. At the other, the sophisticated PP42 has extensive set capabilities, and a choice of 8, 16 or 32 bit mode.

Technical Data available.



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Logic analyser probes

Four new probes extend powerful analysis capabilities to the 68008, 68010, and NSC800 microprocessors, and the IEEE-488 instrumentation bus, using the *Nicolet* 700 and 800 series logic analysers.

Model 66 is a dedicated probe for the 68008 microprocessor, and connects to a DIL package with a 48 pin DIP clip. All data lines are buffered at the probe to ensure completely non-intrusive monitoring of data flow to 10 MHz.

Model 67 offers similar features for the 68010 microprocessor and connects to a dual-inline package. A pin grid array (PGA) adapter is also available.

Model 69 probes the NSC800 microprocessor, an increasingly

popular CMOS version of the Z80. Nicolet's probe features high-impedance buffers to avoid loading of the target system. Unique hardware in the probe can prevent the collection from being cluttered by unwanted bus cycles such as refreshes.

Model 74 is a probe for the IEEE-488 bus, accepting a standard GPIB connector, and allows either timing or state analysis of all data and control lines. When using timing analysis, all lines are displayed and labelled with their GPIB signal names. When using state analysis, full disassembly into GPIB mnemonics is provided for each bus transaction.

Spescom TMS

8707 - 121 on Service Card

Milliwatt power meter

The *Wandel & Goltermann* EPM-1 milliwatt power meter, was designed for very precise rms measurements on the 0 dB and 0 dBm levels. It can also be used as an ALC amplifier. Level and signal generators can be connected to the EPM-1 to give a standard voltage source. If a second instrument is added, very accurate frequency response measurements can be made.

The EPM-1 features high absolute accuracy of level measure-

ment, high relative accuracy on expanded scale $\pm 0,2$ dB, true rms measurement independent of signal waveform, and a calibration source for 0 dBm/0 dB. Test probes are provided for balancing and coaxial measurements. Each EPM-1 has its own calibration curve, overload protection is standard and there is a wide range of accessories available.

PNI Electronics

8707 - 122 on Service Card

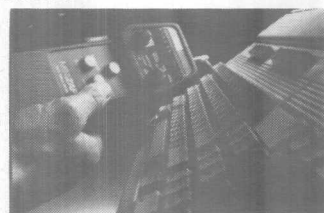
ESD simulator

KeyTek's 'MiniZap' electrostatic discharge (ESD) simulators now make company-wide ESD testing practical.

Available in two standard models, the MiniZap is a one-piece, low cost, rugged unit, which can be operated from built-in rechargeable batteries.

Like the model 2000, MiniZap offers both True-ESD air discharge, and fast rise current injection modes, and meets existing and proposed IEC standards.

The expanded 2000 series is the first to meet the mandatory



requirements of company-wide testing (pulse integrity and repeatability) providing test results that correlate, no matter which model tester is used.

EBE

8707 - 123 on Service Card

Data tester

The new *Wandel & Goltermann* DT-10 data tester is specifically designed for the service engineer testing V.24/RS232C interfaces. This handy battery-operated instrument has an autoconfigure mode which automatically recognises various transmission parameters.

Operation is simplified by the use of a large, high-contrast LCD display and clear menu-orientated programming using softkeys. Features include comprehensive self-test routines for RAM, ROM, display and keyboard functions, and up to eight pre-stored instrument settings. Eight different measurement modes include bit error rate, timing and distortion. Transmission speed can be set anywhere within the range 50 bits/s to 20



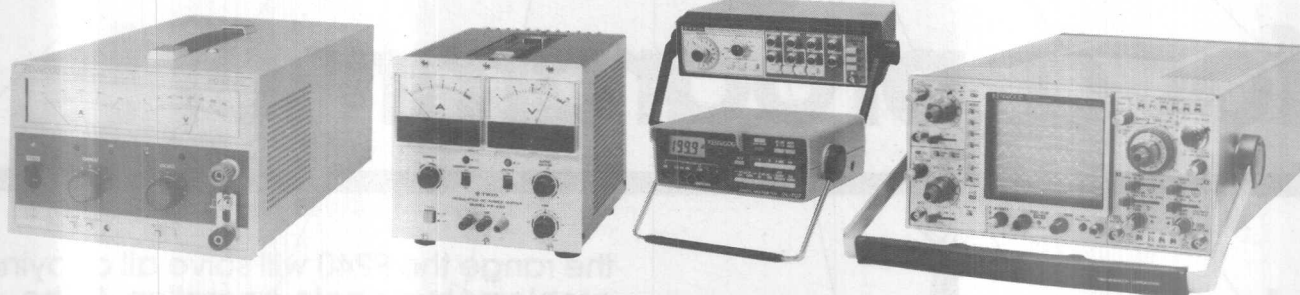
k-bits/s. A DUMP facility outputs all results and instrument setup data to a printer. *PNI Electronics*

8707 - 124 on Service Card

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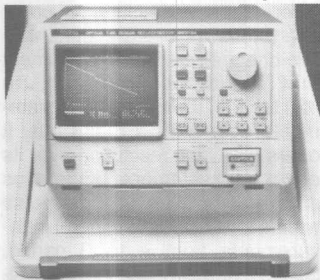
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Compact reflectometer



Anritsu's compact MW910A dual band optical time domain reflectometer (OTDR) offers all the features of a full-sized instrument, yet is small in size (177 x 284 x 381 mm) with a mass of only 13 kg.

The MW910A is capable of long-distance measurements with a maximum measurement range of 144 km and a readout resolution down to 1 m. The wide dynamic range ensures that even at a long distance, breaks and other faults not causing Fresnel reflections, can be detected.

The light source is maintained at a constant temperature, so output light and wavelength are highly stable. This guarantees

that measured results can be repeated as often as required.

A wide variety of measurement types can be efficiently handled by adding on plug-in units to the main frame. Four different plug-in units are available for different wavelength and types of optical fibres. The MH955A, for example, permits fast front-panel pushbutton switching between 1,31 and 1,55 μm light or SM fibre measurement.

All units offer optical masking of up to three points. Fresnel reflections occurring at positions close to each other can thus be easily reduced and loss measured more accurately than ever.

Hard copy results can be obtained with the built-in printer. An optional MZ146A d.c.-a.c. inverter which allows for operation with an external 12 V or 24 V d.c. supply is also available.

An extra built-in LED light source permits diagnosis of the light receiving section and calibration fibre losses can be easily measured with this light source and power meter. *Telkor Sales*

8707 - 126 on Service Card

Analog circuit trainer

The ACT-1 from *E & H Instruments* is a complete analog circuit trainer, containing all of the functions required for studying and experimenting with active filters, operational amplifiers and other analog circuitry. The ACT-1 is short circuit proof and safe for student use, remarkably simple to operate and maintain, and ideal for 'hands-on' electronic instruction at all levels.

Virtually any training circuit can be built on the versatile ACT-1, from introductory experiments to others required for more advanced courses. With the ACT-1, students need not repetitively rebuild the same circuits required by different experiments, permitting concentration on the concepts which is being studied.

Integral to the front panel of the ACT-1 is a function generator circuit providing waveform outputs for amplifier experiments. The

function generator has outputs of sine, triangle, square and TTL levels, as well as AM and FM modulation control lines. A speaker for audio experiments is mounted under the panel.

The front panel also contains a number of uncommitted devices, including an uncommitted SK-10 solderless breadboarding socket.

Each function is internally connected with five tie points to a solderless interface socket. This socket is clearly labelled for patching individual functions.

The ACT-1 is built to withstand regular student use and is protected by a two year warranty for parts and labour. A durable, moulded high-impact plastic case with a hinged cover makes the ACT-1 portable and stackable for secure, convenient storage.

Hurbarn

8707 - 127 on Service Card

In-circuit emulator

The *Adtek* BX-8, 8-bit universal in-circuit emulator is used with an IBM-PC (or compatible), CP/M computer, or even with a dumb terminal, and is designed to completely support software and hardware development of 8-bit microprocessors.

Emulated CPUs are Z80, 8085, 6809/6809E, 8048 series, Z80 C Mos equivalents, 8051 series (8031, 8032, 8051, 8052, 8059, 8752, 80C31, 80C59, 87C51 and equivalents) and 6301.

The extremely user-friendly BX-8 features: realtime trace, trig-

ger functions, register trace, memory mapping, symbolic debugging and in-line assembler, debug command language, step execution, built-in PROM programmer and eraser, built-in help and auto prompting resources, and interactive program development with optional 'ZIL' compiler.

The BX-8 is equipped with 64K mappable emulator RAM, 2048 step trace memory, 256 step register trace memory and more than 50 debugging commands.

Specitec

8707 - 128 on Service Card

We have the power to alarm.

Whatever your power need — from burglar alarms to warning systems in essential services — get the battery that won't let you down when you need it most. Sonnenschein Dryfit from Raylite. Internationally Sonnenschein are leaders in the design of maintenance-free cells, from 1 AH to 1 500 AH. Their Dryfit batteries are deep discharge protected, require only one charger voltage, and can be mounted at any angle. And

they're backed by Raylite's advisory service which guarantees you the

most cost-efficient option.



RAYLITE

RAYLITE BATTERIES (PTY) LTD

Hybrid recorders

New models of hybrid recorders from the well-known recorder manufacturers, *Chino*, have come on the market and are stocked by BRCS Instrumentation.

The AH and AL series of Chino hybrid recorders are advanced compact recorders for analog and digital recording of input values which combine dot recording of analog value trends with digital recording of measured values at a specified time interval – all on a single chart paper. 100 mm and 180 mm charts are used. The AH series includes 6-point and 12-point models and the AL series are small 6-point recorders. The digital recording includes printing of time, year, chart speed and range (scaling), making a permanent record of measurement conditions for data storage.

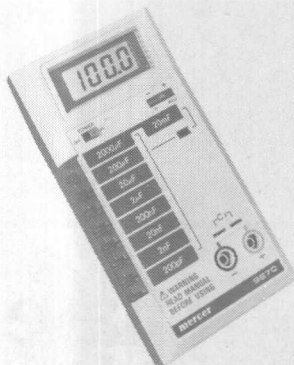
Alarms are provided as standard and can be independently set for each measurement point, enabling separate alarm displays and recording for each point.

EPROM memory, stores and simplifies scale calibration and provides backup, protecting valuable setting conditions for more than 10 years.

BRCS Instrumentation
8707 – 130 on Service Card

Capacitance tester

A new range of instruments made in the Far East by Simpson, and marketed under the name of Mercer, includes a 3½-digit, high accuracy capacitance meter, model 9670, which sells for R295,00 and has nine ranges from 0 – 200 pF to 0 – 20 mF.



The resolution of the reading is 0,05 % and the basic accuracy is 0,5 %. The meter uses a normal 9 V battery, is fused, has over-range and 'LO BAT' indication, and weighs under 350 g. The case is flame retardant, high impact thermoplastic and has an acrylic window. Peter Rothenberg
8707 – 131 on Service Card

TV pilot level meter

The *Wandel & Goltermann* TPM-10 TV pilot level meter is designed to measure pilot levels on broadband TV systems. Measurements, at fixed frequencies, may be continuous wave or vision carrier signals. In the latter case the instrument measures the rms level of the line synchronisation pulses, and is unaffected by picture modulation.

Level measurements at the three switch-selected frequencies are fully automatic. Any level within the instrument range may be displayed with 0,1 dB resolution on the backlit LCD display.

PNI Electronics
8707 – 132 on Service Card

Miniature passive voltage probe

The new *Tektronix* P6103 miniature passive 10X, 50 MHz voltage probe, designed for use with the latest 2225 oscilloscope, features a modular probe head and cable with attached BNC assembly.

The probe head houses all circuitry, including low-frequency compensation adjustments and features a new replaceable screw-in probe tip. The hybrid probe tip circuitry provides more uniform probe tip compensation for better high frequency response with reduced aberrations. Input resistance is 9 MΩ and input capacitance is nominally 10,9 pF at 1 MΩ, 13,2 pF at 2 MΩ, and 15,5 pF at 3 MΩ. PNI Electronics
8707 – 133 on Service Card

Counter/timer with totaliser function

The *Keithley* 775A programmable counter/timer, which includes a totaliser function for applications where it is necessary to count every time an event occurs, is a two-channel, half-rack instrument that measures from d.c. to 120 MHz (standard). Programmable over the IEEE-488 bus, it offers nine digit resolution over its entire measurement range plus such standard features as pulse widths to 10 ns, time interval measurements from A to B period, period averaging, and low pass filter (to eliminate false triggering).



An extra measurement range on an optional, high-frequency third channel, Channel C, provides a range of 50 MHz to 1,3 GHz. The option package also includes a temperature compensated crystal oscillator for a more stable time base with measurement drift less than 0,1 ppm per month.

PNI Electronics

8707 – 134 on Service Card

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Contact Westplex for details on MEASURECOMP and the growing selection of MEASURECOMP modules, including multimeters, triple programmable power supplies, multiplexers, frequency counters etc.

Find out what savings MEASURECOMP can achieve for you. Westplex also supplies a range of PCs and printers for your technical applications.

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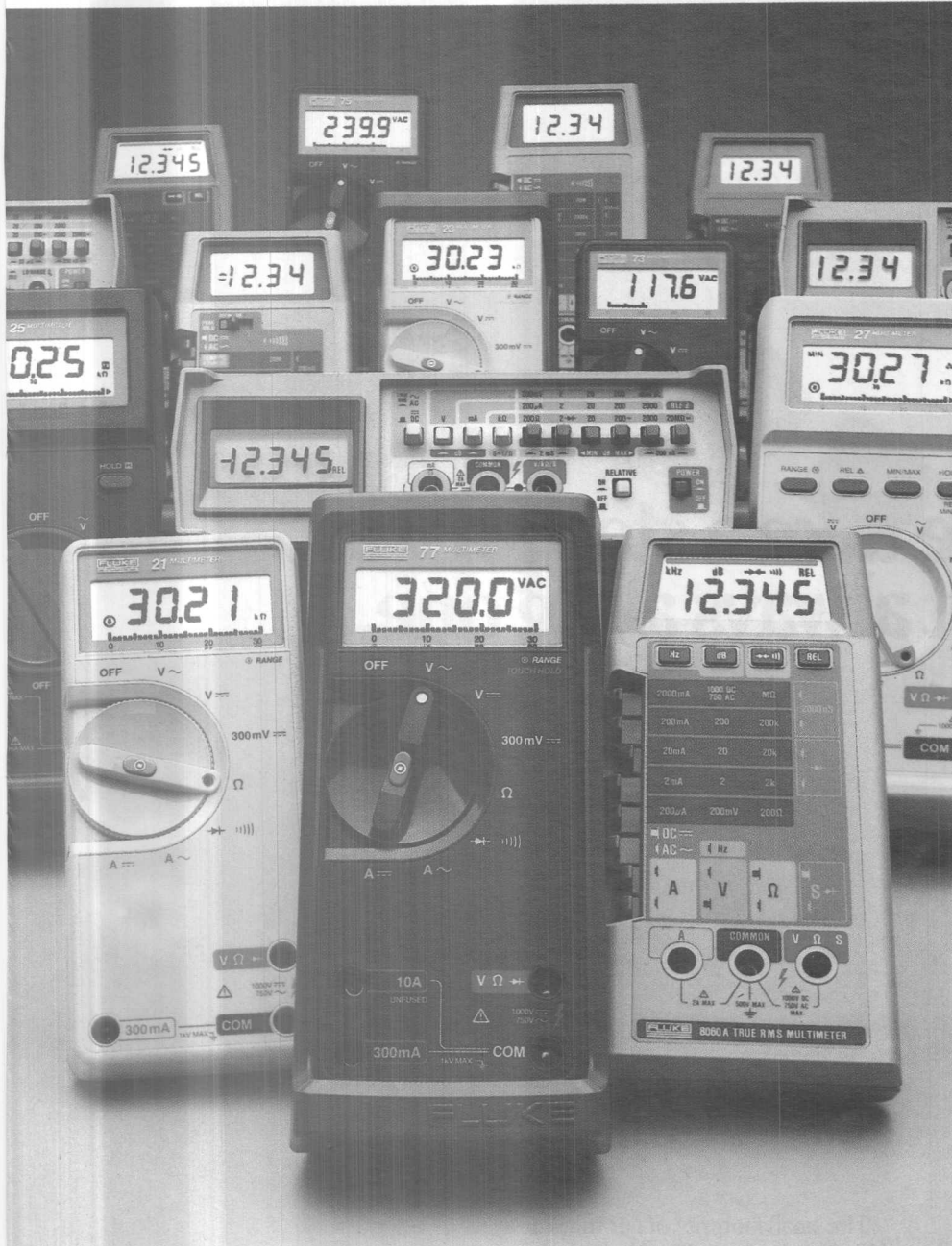
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Fluke comes in first again with the world's largest selection of quality accessories to help extend the capabilities of your DMM even further.

There's no need to look anywhere else. Uncompromising Fluke design and leading edge technology are the reasons why attempts at imitation will never fool the millions of professionals that accept nothing less than a Fluke.

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Natal: Al Radio, Durban, Tel: (031) 23-1111/4.

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Ltd., Bloemfontein, Tel: (051) 30-3741.

Mittlek OFS (Pty) Ltd., Welkom,
Tel: (0171) 2-9982.

Zimbabwe: Electra Source (Pty) Ltd., Harare,
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S.W.A./Namibia: Heltronix (Pty) Ltd.,
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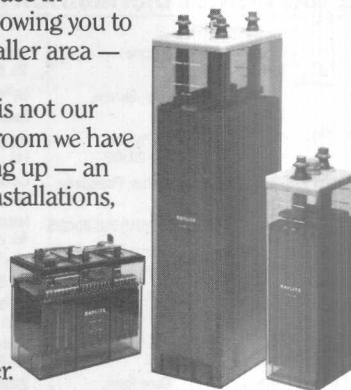


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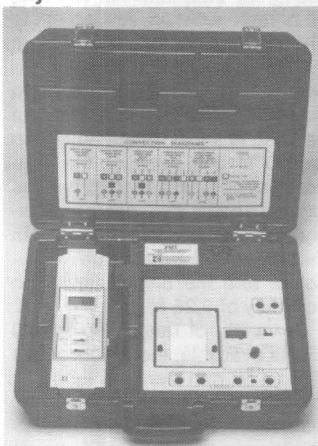
RAYLITE
RAYLITE BATTERIES (PTY) LTD

T & M

Load surveyor

The *Esterline Angus* PMT – a.c. motor/load surveyor is designed to examine single and polyphase electrical loads in order to locate and diagnose those areas in a facility that will produce the greatest electrical energy savings, by providing measurements and printout of all critical electrical power parameters:

- ☐ determine motor efficiency – prints out instantaneous values of current, voltage, watts, vars, kVA and power factor. The inrush feature can help determine starter requirements;
- ☐ determine if loads are balanced – printouts of kW-hours, kVAr-hours and average power factor identify areas of wasted electricity and allow for economic analysis of where electrical efficiency can be improved and how to improve it;
- ☐ target areas for greatest savings – identify peak electrical demand and power consumption at a facility's main service or individual loads. These measurements, plus kVAr-hours and average power factor, can be used to pinpoint those areas of maximum electrical inefficiency.



All the equipment needed to make power measurements are housed in the unit's rugged carrying case. For ease in use and hookup, leads are colour-coded and a colour-coded connection diagram is provided on the instrument's case. For ease in the selection of the type of printout desired, the instrument's power reporter module is colour-coded.

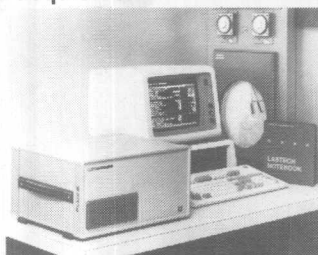
Estech

8707 – 138 on Service Card

PC-based data-acquisition

A new software package from *Fluke* enhances the data-acquisition of the *Fluke Helios-I* Computer Front End. *Labtech Notebook* software has been adapted specifically to work with *Helios-I* drivers and facilitates the gathering and recording of data and provides a useful data output via analysis routines, such as real-time graphic displays. Data is further analysed through *Notebook's* direct interface to other programs like *Lotus 1-2-3*, *Symphony*, *RS/1*, or *NWASTapak* for analysis, graphics and data base management.

Combining *Helios-I* with *Labtech Notebook* allows the measurement of virtually all physical parameters including temperature (thermocouples and RTDs), flow, pressure, strain, pH, voltage, current, resistance and frequency/event counting. It accepts status, binary and BCD inputs. Outputs



include status (digital), analog (current and voltage) and relay contact closure.

The program is flexible, permitting sampling rates to vary from channel to channel during a run. *Notebook* has foreground/background capability, allowing a PC to be used for other programs while collecting data. The package also includes several analytical routines, including nonlinear curve-fitting.

PNI Test Systems

8707 – 139 on Service Card

General purpose counter

A new, low cost bench counter, the 1990 universal counter, was recently launched by *Racal Dana*.

For research and development, production, and service engineers, the 1990 provides fast, good resolution measurements of the most regularly used parameters. A GPIB option extends the instrument's capability into ATE applications, while an internal battery module makes it ideal for field use.

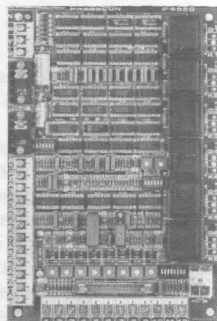
The 120 MHz 8-digit counter

measures frequency, period, time interval, phase, totalise, time and ratio. It also has the additional capability of single key nulling, averaging, delay hold-off and single-shot measurement. Two wide bandwidth d.c. amplifiers give excellent flat frequency response and pulse handling to ensure minimum miscount and precise triggering. Recipromatic operation provides 7-digit resolution in 1s.

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8707 – 142 on Service Card

measurement

Manometer/calibrator

The Meri-Cal portable digital manometer/calibrator has a dual LCD type display which indicates pressure applied and electronic transducer/transmitter voltage or current output simultaneously.

Pressure is indicated in any of eight key selected engineering units, inches H₂O, cmH₂O, psi, inches Hg, mm Hg, Kg/cm², kPa, mBar and programmable units conversion factor. Models LP 2001 (50 kPa) and LP 9001 (225 kPa) are also available in differen-

tial pressure versions. Accuracy is $\pm 0.05\% \pm 1$ digit NBS traceable.

The Meri-Cal has rechargeable NiCad batteries, and operates continuously for over 40 h at 21 °C between charges and over a temperature range of -4° to 50 °C. A complete range of mechanical fittings, air supply, chargers and electrical test lead kits is available.

Protea Industrial Controls
8707 - 143 on Service Card

Temperature sensors

Sfernice-Ultronix has introduced the CTS range of wirewound temperature sensors with temperature coefficients of resistance from -50 to +6000 ppm/°C.

Various combinations of alloys and metals are used to obtain a wide range of resistance changes with temperature for trimming, tracking, compensation and

matching.

The units can be made available in metal housings such as brass, aluminium or stainless steel, together with various encapsulants for different temperature range requirements and environmental conditions.

ECs

8707 - 144 on Service Card

Liquid level measurement

Sensotec have designed a unique strain gauge transmitter (LL-F) for installation in the side of a tank with an ANSI flange. The small diameter diaphragm at the end of the horizontally inserted tube does not require a fluid-filled capillary. The unit can be used in liquid temperatures up to 160 °C and because the temperature compensating circuitry is located near the sensing diaphragm, the effects of changes in media temperatures are eliminated, and the unit achieves an accuracy of 0.25 %.

A variety of ranges up to 690 kPa is available, the lower ranges using a 57 mm diameter tube and the higher ranges using a 38 mm diameter tube. The insertion tube can be any length from 50 mm to 380 mm.

The unit requires a supply of 26 to 32 V d.c., and gives an output of 4 - 20 mA (3-wire). The electronics includes zero and span adjustment, and built-in shunt calibration.

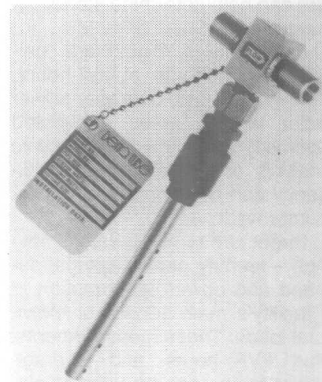
Peter Rothenberg

8707 - 145 on Service Card

Pitot tube sensor

The Delta tube from Mid-West Instrument is a primary averaging pitot tube flow sensor for liquids, gas and steam. A variety of measurement and control devices have been specially made to complement the sensors including: differential pressure gauges; switches; solid state alarm controls; surge and overpressure devices; and portable flow measurement kits.

Three basic models of the Delta tube cover a broad range of different pipe sizes and flow rates. Hot tap versions are also available.



The sensor functions by generating a differential pressure proportional to the square of the flow. Four separate inlet ports give true averaging readings across the complete line section and, as they create minimum flow restriction, there is also greater accuracy which is $\pm 1 - 2\%$ of actual flow. Installation is easy and cost saving, and the non-clog design reduces maintenance to a minimum. Repeatability is also excellent.

BRCS Instrumentation
8707 - 147 on Service Card

Conductivity sensors

The new Foxboro 871EC-SP and -HP electrodeless conductivity sensors have been designed for corrosive and high temperature applications. The new models are the most recent additions to the 871EC family of sensors and are designed to work with Foxboro 870EC transmitters and electrochemical monitors.

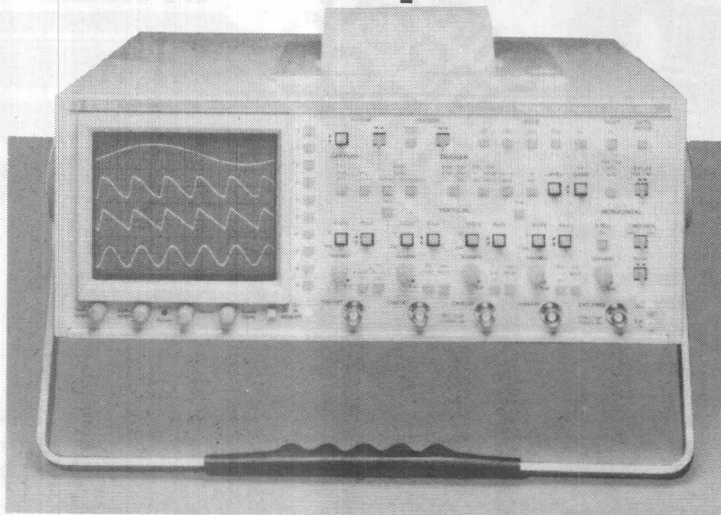
The 871EC-SP sensor features PEEK (glass-filled construction) for use in 'chemically abusive' process streams. The sensor is suited for most aqueous solutions of acids, bases, and salts as well as organic solvents such as toluene, ethyl acetate, acetone, petrol and carbon tetrachloride.

The 871EC-HP is a highly specialised sensor for similarly corrosive streams at high temperatures up to 200 °C and pressures up to 1.7 MPa. It is engineered for use with an integrated platinum RTD for automatic temperature compensation.

AFH Devers

8707 - 148 on Service Card

The GOULD 1604 multichannel digital storage 'scope



- 20 MHz bandwidth ● 4 channel operation ● Time resolution to 50 ns (20M sample/sec sample rate-in single or dual channel operation) and 100 ns (10M sample/sec sample rate-in 4 channel operation) ● Glitch capture ● Fully programmable ● Internal digital plotter ● Realtime operation ● Horizontal expansion up to 200 times ● Waveform processor to give a wide range of both pre- and post-storage functions ● Plug-in storage of up to 50 traces in non-volatile memory ● Realtime clock ● Trigger delay ● On-screen cursor to quickly measure both voltage and time ● Digital storage of X-Y display ● Optional IEEE488 or RS423 interface.



Altech Instruments

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Altech Instruments (Pty) Ltd

8707 - 146 on Service Card

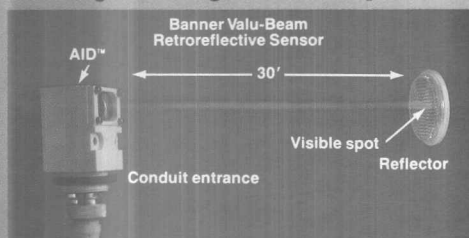
At Last, Low-Cost Photoelectrics Tough Enough To Take It.

Revolutionary New Design Means Rugged Performance. In hostile industrial environments, many photoelectrics haven't got a fighting chance. But the new Valu-Beam™ from Banner is built to stand up in the toughest industrial applications.

This compact, self-contained sensor gives you up to 4 times more beam strength than other comparably sized units. Up to 10 metres for retroreflective scanning; 0 to 60 metres for opposed scanning.

The Valu-Beam's circuitry is encapsulated in epoxy and housed in an impact-resistant, Valox housing (NEMA-4 rated to be water-tight). The unit's custom-designed, CMOS integrated circuit provides better resistance to ambient light, vibration, temperature variations, and electrical noise. And the Valu-Beam's conduit entrance with its quick-disconnect coupling makes the sensor extra rugged and easily interchangeable on the line.

Visible Beam and AID™* for Easy, Accurate Alignment. The Valu-Beam's visible LED light beam makes alignment as easy as pointing a flashlight. AID, Banner's patented Alignment Indicating Device, is a built-in, second alignment system that shows *both* alignment and exact signal strength. With AID, you know at a



*Patent No. 4356393 and other patents pending.

glance whether contaminant build-up or misalignment is affecting your system.

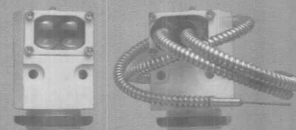
More Scanning Options for More Applications.

The new, conduit-entrance Valu-Beam is available in five scanning modes — retroreflective, opposed, diffuse, convergent, and fiber optic — in 3-wire, AC or DC models. Simple screwdriver adjustments let you control sensitivity and select light or dark operation. The Valu-Beam's low leakage current means it can interface directly with all programmable controllers. The unit can be flush-mounted or mounted by its threaded base, making it the easiest sensor to install on conveyors. The Valu-Beam is also available in an easy-to-install, prewired model. Finally, the Valu-Beam's low price makes it one of the most economical sensors around.

Want to Know More? Contact

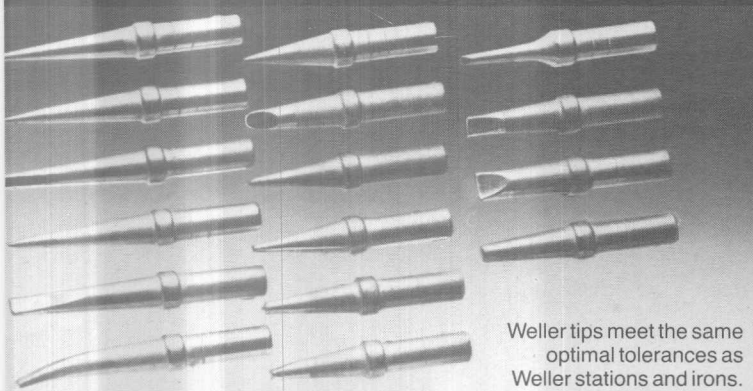
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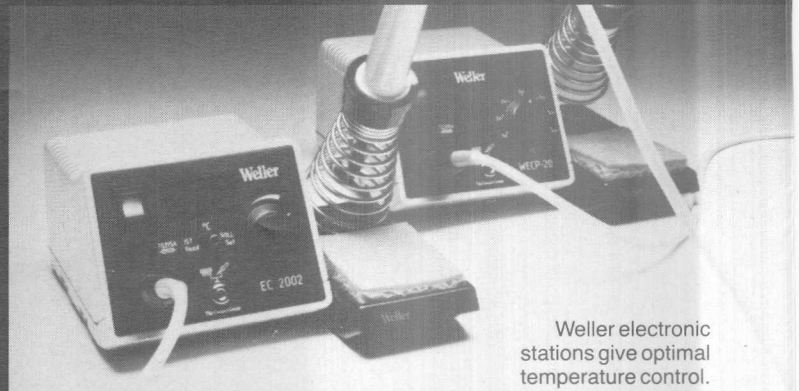


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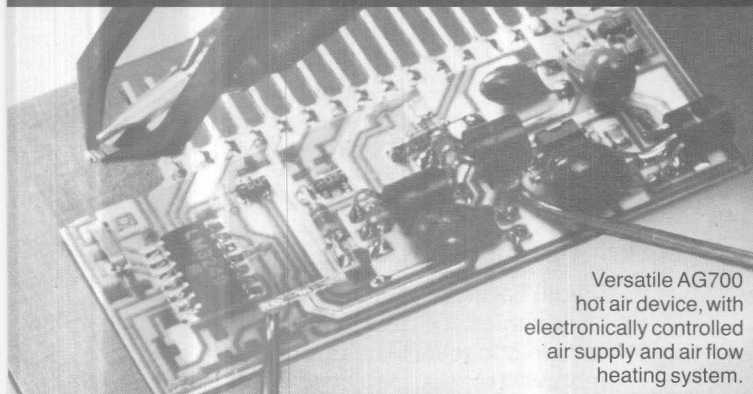
Weller. The name for today's technology.



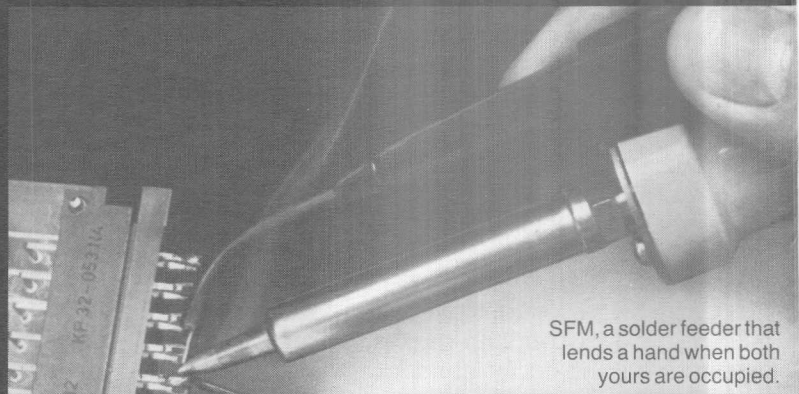
Weller tips meet the same optimal tolerances as Weller stations and irons.



Weller electronic stations give optimal temperature control.



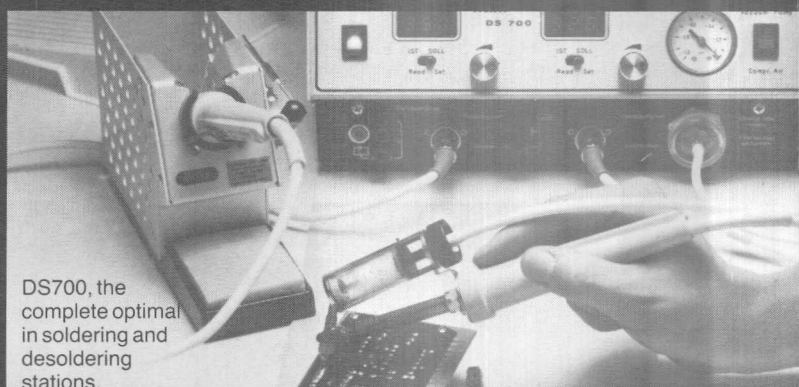
Versatile AG700 hot air device, with electronically controlled air supply and air flow heating system.



SFM, a solder feeder that lends a hand when both yours are occupied.



VP801EC, a total portable desoldering station with its own built in vacuum pump.



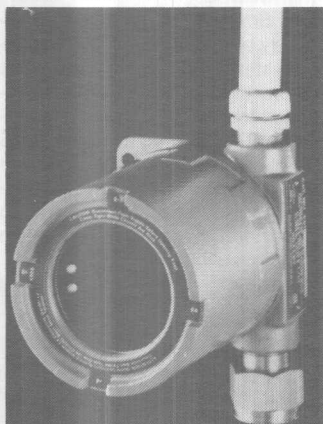
DS700, the complete optimal in soldering and desoldering stations.

Weller soldering tools are made to exacting tolerances. They meet the standards of precision and technological demands of today's electronic industry. For more detailed information contact: Vitaphone (Pty) Ltd. P.O. Box 4637, Johannesburg 2000, Telephone: 337-1454/5, Telex: 4-82163 SA.

Please telephone us for the name of your nearest distributor.

CooperTools VITAPHONE (Pty) Ltd.

Combustible and H₂S sensor/transmitter

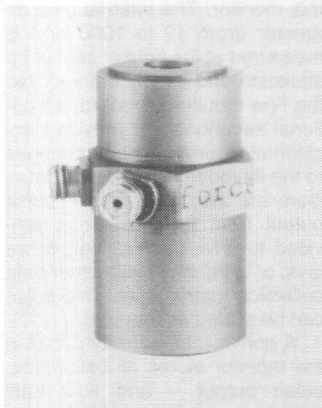


The *Rexnord* models 400 and 410 standalone combustible and H₂S sensor/transmitter assemblies are designed to serve as standalone systems that can be linked directly to remote terminal units, distributed control systems or any type of computer control system. In addition, they may be provided with Rexnord's single, dual or eight-channel controllers.

The models 400 and 410 assemblies also save time by allowing one person calibration without the need to open the junction box in the field and feature a sensor sensitivity check to quickly determine remaining sensor life during calibration. *Action Instruments*
8707 - 151 on Service Card

Driving point sensor

PCB has introduced a small size driving point (mechanical-impedance) sensor model 288A11 which combines both quartz force and motion sensors and micro-electronics signal conditioners in a single 16 mm diameter by 31 mm high package which weighs only 45 g.



Sensitivity to force is 2,2 mV/g and acceleration 100 mV/g. The sensor measures both force and motion at the driving point when vibration testing the transactional behaviour of interacting structures. The 288A11 operates from standard *PCB* power signal conditioners which provide 2 to 20 mA constant current.

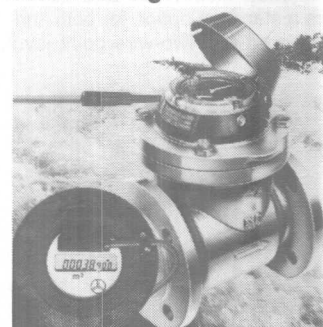
Altech Instruments
8707 - 152 on Service Card

Remote water meter reading

The *Meinecke* Cosmos Data System (CDS) enables water engineers to obtain data from inaccessible meter locations and read maximum and minimum flows on a 24 hour basis.

The CDS uses CMOS technology and is compatible with standard IBM type data processing systems. This feature makes individual interrogation of meters possible to facilitate capture of data such as its serial number, year of manufacture and flow rates. With additional programming, the unit can also become a valuable fault finding aid.

The unit requires no external power supply as it is self powered by a battery with ten year life expectancy and features an LCD



display for visual reading when necessary and total encapsulation to prevent misting. The use of both analogue and digital technology makes the CDS exceptionally versatile.

Liquid Meters
8707 - 153 on Service Card

Non-indicating flow-operated switch

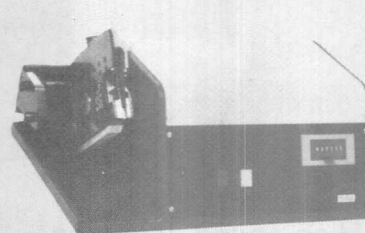
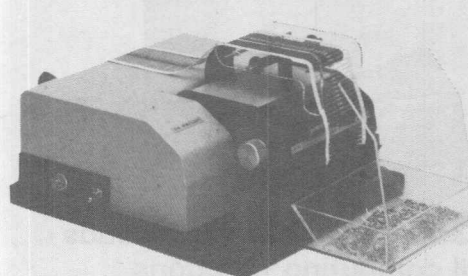
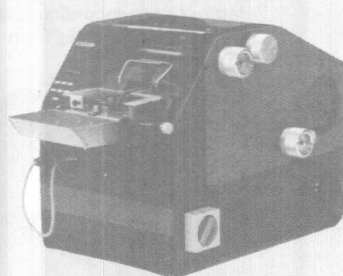
The *Floscan* Type BM flow alarm from *Platon* is a non-indicating flow-operated switch which fits directly into 6 to 150 mm nominal bore pipework for use with a wide range of liquids and gases.

The variable area flow sensing element embodies a permanent magnet and is mounted on the pipe axis, adjacent to a transverse pocket which contains a reed

switch. This is orientated in the strongest field of the operating magnet and provides reliable and failsafe operation for optimum plant efficiency and safety. A wide range of pre-set switch rates is available, along with materials of construction, to meet the most exacting applications.

Action Instruments
8707 - 154 on Service Card

If you prefer slow, inaccurate, manual methods of preforming electronic components — you won't need our fully automatic cutting, crimping & bending machines



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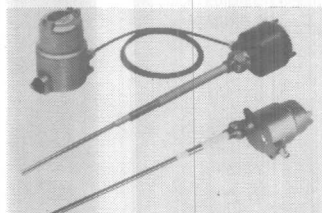
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measurement

Point level controls

Drexelbrook now offers integrally mounted electronics and sensor as a standard option for both line-powered and two-wire point level controls.



Regardless of the mounting configuration, the point level controls are ideal for reliable measurements in liquids, slurries, granulars and interface installations. The company's Cote-Shield electronics allows the instruments to ignore the effects of coatings on the sensor, and the no-moving-part design ensures low maintenance and long instrument life.

Protea Industrial Controls
8707 - 156 on Service Card

Scale printer

The IDS 150 scale printer interfaces with most digital weigh indicators and 'smart' terminals used today.

Incorporating a high quality micro-computer-controlled dot matrix print head with 40 character storage buffer, the unit offers multiple ticket printing, and automatic document advance as standard features. Serial interface inputs are RS232 or 20 mA current loop. A cable of specified length can be supplied to connect a selected output device to the IDS 150.

Standard user selectable feature is the invert option which prints a mirror image that will read correctly when the ticket is removed (used when printing on the left hand side of forms that are wider than the printing area). Column width can be reduced to 20 characters if required.

SA Automation
8707 - 157 on Service Card

Digital flow monitor

The Model 1000 low cost digital flow monitor, from *Data Industrial*, is a compact, microprocessor based flow monitor with an LCD which displays either rate of flow or total flow in a choice of measurement units at the touch of a button.

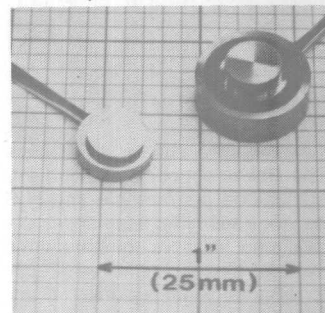
Field calibration is easy with this monitor. The internal pipe diameter (from 12 to 1000 mm) is measured at the time of sensor installation and simply entered into the flow monitor keyboard. An optional security cover prevents accidental or unauthorised changes to the keyboard. Mechanical totalisers are also available. A pulse output from the monitor is provided to drive the totaliser, or relays, or to interface with other data collection instruments. This pulse can be scaled as required.

A nonvolatile memory circuit in the monitor stores all calibration, pulse output - and flow total figures even in the event of power failure.

BRCS Instrumentation
8707 - 158 on Service Card

High sensitivity pressure transducer

The *Entran* EPN series high sensitivity pressure transducers measure static and dynamic pressures where high resolution in a miniature transducer is of prime importance. The sensing area is only 45 mm², in a flush mounted corrosion resistant stainless steel diaphragm and is suitable for use in water and corrosive fluids which are compatible with 304SS.



Complete thermal compensation is a standard feature and available in both internal and external modules. Two mounting styles are available including an o-ring version. Semiconductor strain gauge construction results in a noise free full scale output to 350 mV, requiring no amplification.

Combined nonlinearity and hysteresis is available as low as 0.1 % FS and ranges are from 35 kPa to 35 MPa, with dynamic range from static measurements to 40 kHz with resonant frequencies as high as 200 kHz. Operating temperature range from -40 °C to 121 °C.

Accutronics
8707 - 160 on Service Card

Temperature printer

The KM 1202, a new fully portable temperature printer with five inputs, from *Kane-May*, provides temperature recording facilities for up to five channels from type 'K' thermocouples.



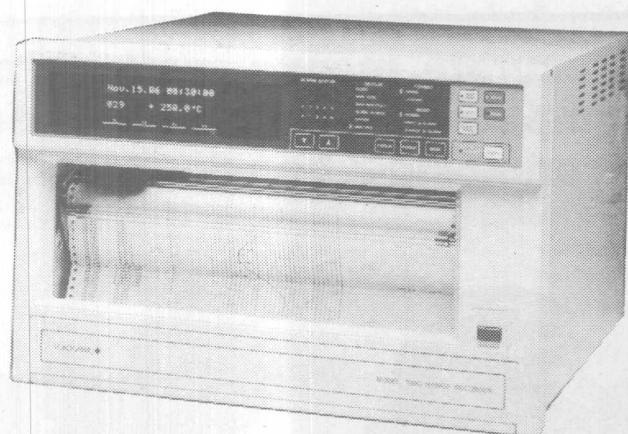
A date/time clock notates each reading in hours, minutes and seconds so precise records can be kept over the range -100 to 1300 °C, with print time intervals being user selectable from 10 s to 60 min. On power-down, average, maximum and minimum readings of each selected channel are printed.

The KM 1202's resolution is 0.1 °C and differential measurements are also available via the touch-sensitive key pad which includes audible tone. Battery life is up to 500 h.

Martech Controls
8707 - 161 on Service Card

YOKOGAWA

HR 2500 HYBRID RECORDER



- High speed scanning — 300 channels in 2 seconds
- Remote scanning
- Full computing functions
- Full alarm capability
- User programmable scaling and Delta T measurement
- GPIB
- RS232C
- Flexible printing formats and modes with clear distinct 6 colour traces.

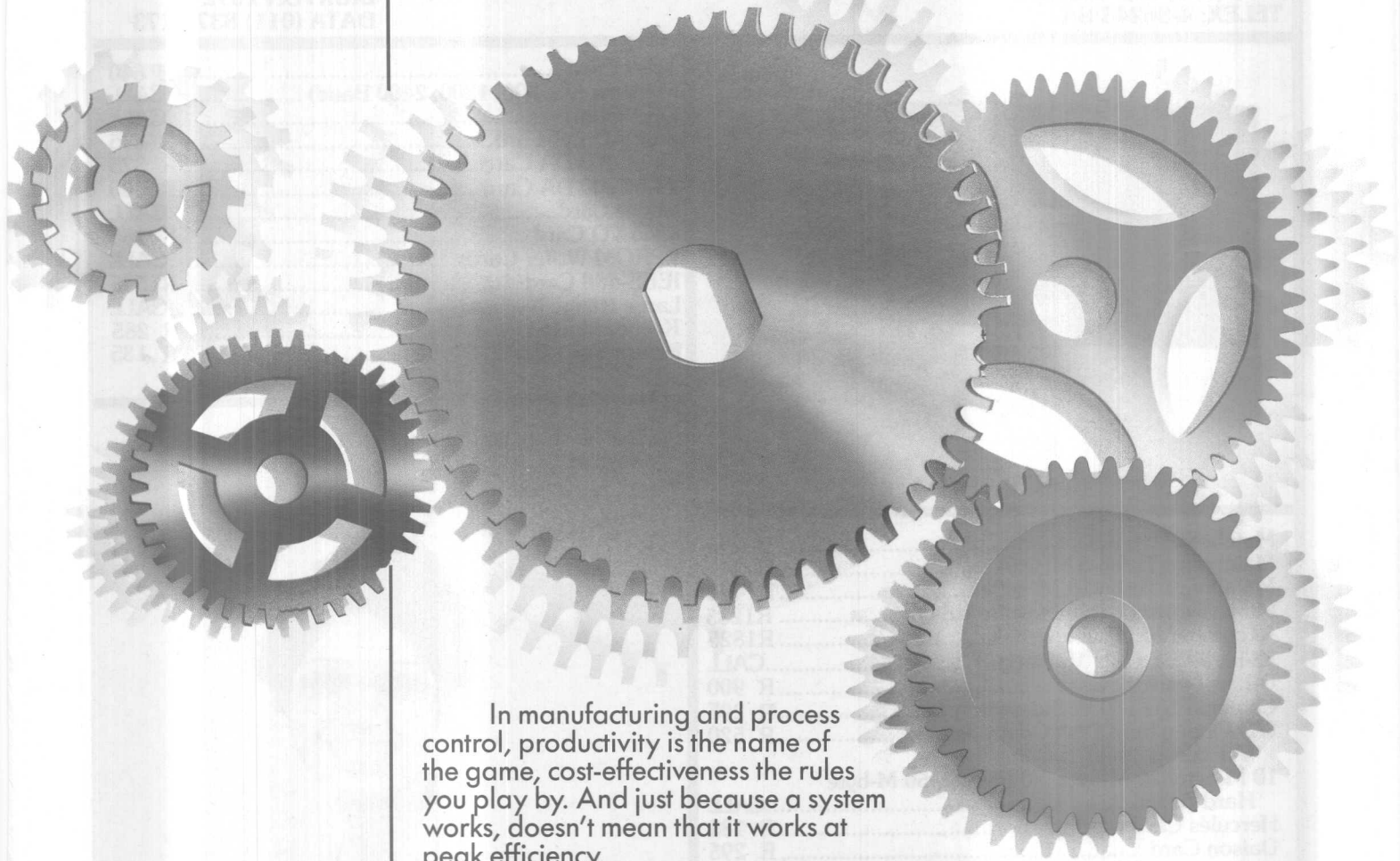


Altech Instruments
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Your system might work, but it could work a lot better.



In manufacturing and process control, productivity is the name of the game, cost-effectiveness the rules you play by. And just because a system works, doesn't mean that it works at peak efficiency.

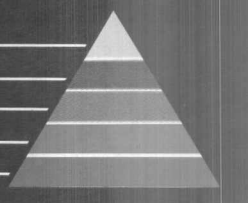
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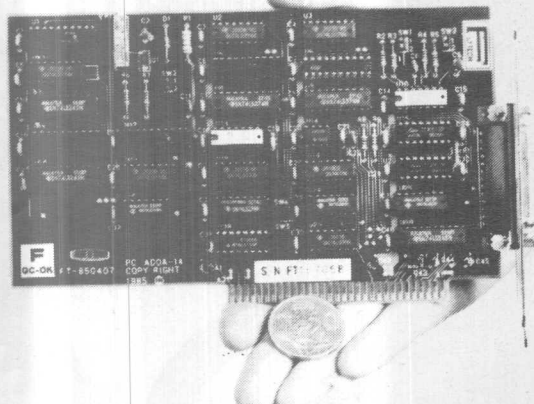
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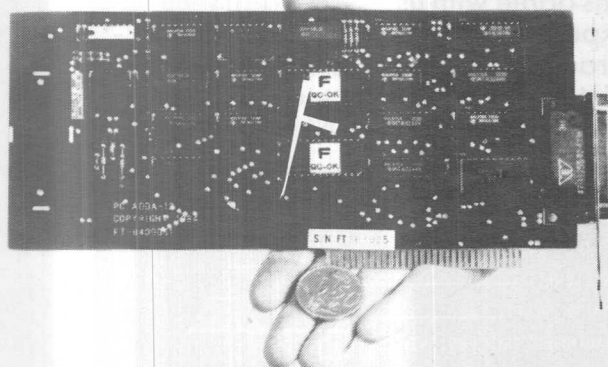
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MD-7 640 × 200, 720 × 350 20 MHz CGA/EGA	
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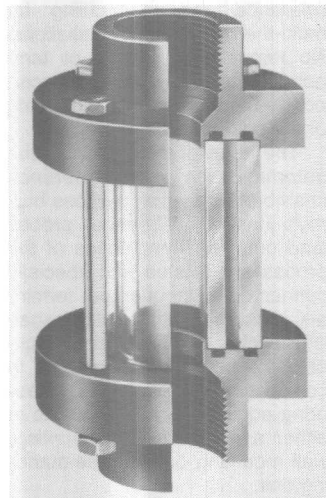
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870623-1

measurement

Level flow indicators

Simple construction and all round visibility are the dominant design features of a range of flow and level indicating sight glasses.



The indicators provide a 360° viewing area through which the presence or clarity of liquid in a piping system, or the level of fluid in a tank may be determined easily, from a reasonable distance.

The flow indicators are ported and offer little or no resistance to normal flow in the pipeline. Turbulent liquids or those with entrained air bubbles are generally easy to observe but when the process fluid is either clear or opaque, a mechanical fluttering device is obtainable as optional equipment.

Sight glasses may be of single or double cylinder wall construction, depending on duty and the type of liquid handled. Indicators range in pipe sizes from 12 to 200 mm.

Ascoreg

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Pressure transducers

Datatech pressure transducers are extensively used by companies in the aerospace industry. Due to the high accuracy and stability these are used for critical measurements of fuel tank capacity and differential pressures between the inside of the capsule and the atmosphere.

Also available is a range of industrial pressure transducers with 4-20 mA or 0-1 V output for full scale pressure. Pressures can be measured as gauge, differential, true differential, and absolute.

The operating pressure range can be from 35 kPa to 35 MPa.

To complement the range of pressure transducers is a range of multi-channel ultra violet recorders, transient response analysers, and waveform recorders.

OEN Enterprises

8707 - 164 on Service Card

Bulk material flow detector

The Granuflow DTR 131 Z bulk material flow detector from *Endress + Hauser* detects the movement of bulk material in or on feeder systems and, when integrated into the installation, can contribute to energy saving by switching off the conveyor system when no material is being transported.

Features of the Granuflow detector are: direct mounting on the outside wall through windows or holes in the transport duct; contactless detection of movement; movement sensing up to 1 m from the detector; and insensitivity to build-up, or air currents and dust in the pneumatic transporting airstream. The response sensitivity is adjustable and the switching delay can be up to 10 s.

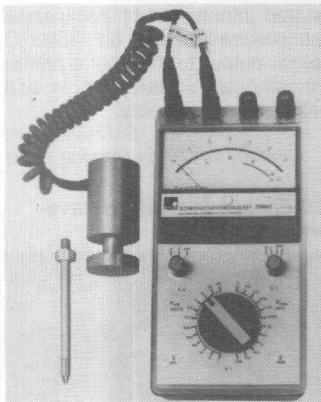
Endress + Hauser

8707 - 165 on Service Card

Portable vibration meter

Monitoring of condition of rotating machines or almost any other piece of machinery is simply achieved using the *HBM* type SM 60 vibration meter.

The SM 60 measures rms values of vibration velocity between 10 and 1000 Hz and also indicates peak values of vibration amplitude. It meets all requirements of the following standards and guidelines: DIN 45666; VDI 2056; ISO DR 2372/2373 and BS 4675:1971.



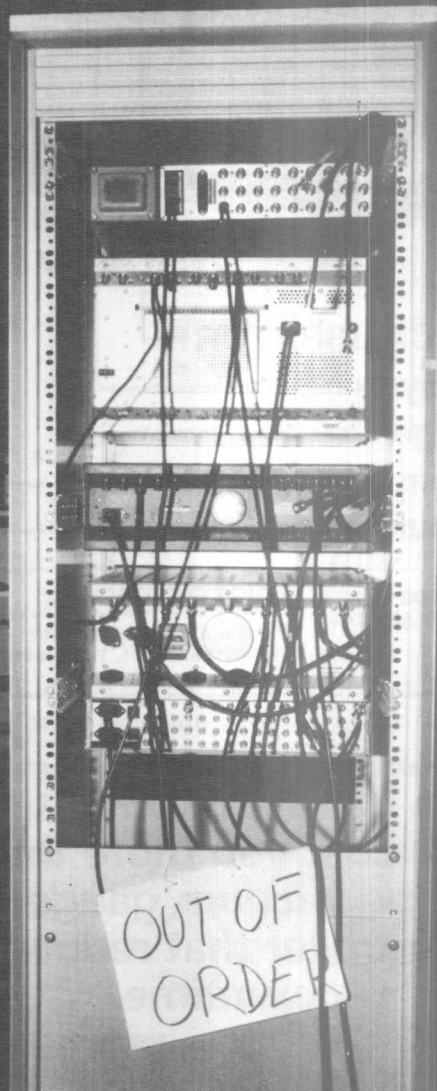
Weighing only 1 kg, the instrument is supplied as standard with test probe and transducer mounting flange. Also supplied as standard is a durable leather carrying case with shoulder strap.

The SM 60 is battery powered and is extremely sensitive (range 0.2 mm/s to 60 mm/s vibration velocity, and 2 to 600 μ m vibration amplitude). Oscillographs or high speed recorders may be connected directly to the instrument in parallel with the transducer signal input.

H. Rohloff

8707 - 166 on Service Card

Somebody hasn't heard of PACE repair systems...



Troubleshooting and repair is an expensive business, particularly in the field of sophisticated electronic systems.

One company has gone to a lot of trouble to help cut service time - and thus costs - to a minimum.

PACE offers a variety of continuous vacuum desoldering systems, all of which include "spike-free" facility for MOS components. There is also a compact portable system suitable for bench use, or in the field.

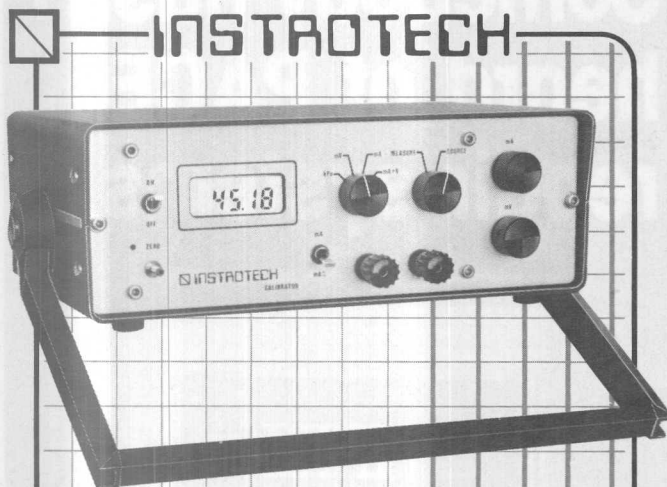
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ems

8707 - 167 on Service Card



CAL 45 V I P

THE CALIBRATOR

Display - 4 1/2 Digit LCD

Voltage - 200,00 mV in / 50,00 mV out

Current - 200,00 mA in / 20,00 mA out

Pressure - 200,00 kPa

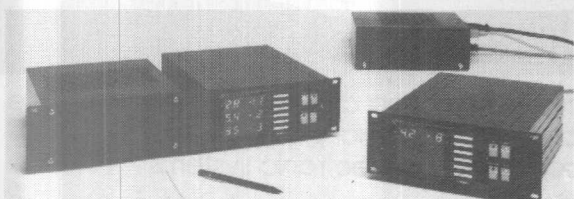
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CAL-45 VIP

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**One Minute of downtime
can cost you more than
the vacuum gauge
controller that reduces
downtime.**



Introducing the GRANVILLE PHILLIPS 307 VACUUM GAUGE CONTROLLER for use with ionization, Convectron and thermocouple gauges.

Features:

- Single ion gauge controller
- Controls up to four gauges
- Measures pressure from 5×10^{-12} to 990 Torr
- Controls up to six external process functions
- Available computer interfaces allow remote operation and data acquisition
- Five year limited warranty



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P.O. Box 5293, Weltevreden Park 1715 South Africa
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8707 - 169 on Service Card

measurement

Combustion efficiency analyser

Teledyne's MAX5 combustion efficiency analyser, continuously monitors important flue-gas parameters with a built-in pump bringing the gas through a field-proven sampler to provide its sensors with a clean sample.

Combustion efficiency is automatically calculated based on current readings of flue-gas parameters - oxygen, carbon-monoxide, total combustible gases, and temperature.



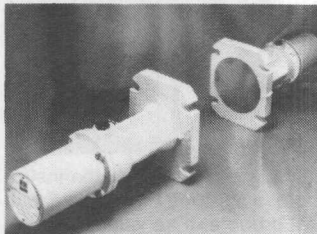
The actual combustion efficiency of the process is compared to that of an ideal boiler operating at the same temperature at excess oxygen and information is provided to reduce fuel costs and minimise atmospheric pollution.

Other features include: automatic calculation of cost savings based on actual fuel prices and calculated efficiency; storage of a wealth of parameter readings for recall; print out of current or stored information or instructions as required, using an RS232C serial output to the user's printer or computer; screen prompts; and 40 k-bytes of memory.

Salvage - SAI

8707 - 170 on Service Card

Underground microwave level switch



The FTR 5181Z from Endress + Hauser, for the non-intrusive detection of the level of solids, liquids or powders underground, is designed to meet safety regulations in the mining industry. It meets NCB requirements for fail-safe operation and is not affected by light, sound, condensation or dust.

Certified intrinsically safe to BS 1259, it can be installed retrospectively.

Endress + Hauser

8707 - 171 on Service Card

Thermocouple calibration

Delristor's Icell range of automatic 0 °C thermocouple reference and marshalling systems, provides convenient and stable 0 °C reference and marshalling for multi-thermocouple installations. No temperature sensor or temperature control system is incorporated, nor is any manufacturing or periodic calibration required.

The heart of the system is the automatic ice point reference chamber from which purpose built multi-junction reference probes lead out. The flying leads of the probes are twisted and specially connected to input/output terminals within the isothermal marshalling enclosure. The unit is suitable for use in remote sites in conjunction with sensitive measuring equipment. It is available in either a 475 mm rack mounting, wall mounting or as a free-standing unit.

Capacities are between 10 and 100 measuring junctions in multiples of 10 junctions. The thermocouple materials can be of any of the commonly used types and can be mixed on one Icell system in multiples of 10 junctions.

Temperature Controls

8707 - 172 on Service Card

Rotating machinery diagnostics

Bently Nevada's ADRE 3 (automated diagnostics for rotating equipment) allows users to acquire and reduce vibration data for performing diagnostics on rotating machinery.

Rapid data acquisition and reduction is achieved by the ADRE 3 system's ability to simultaneously capture eight channels of dynamic vibration data during start-up and shutdown or while a machine is operating at a steady speed.

ADRE 3 consists of one or more 108 data acquisition instruments, application software, and an IBM PC-AT or Compaq Portable II host computer system.

Up to ten instruments can be connected in parallel to simultaneously capture vibration data from 80 channels and inputs can be accepted from a wide variety of vibration transducers including proximity probes, velocity transducers and accelerometers. It captures, stores and processes up to 320 vector data records and 32 waveform data records per channel. Sampling can be performed manually or by programming the unit to store in increments of time, shaft rotative speed or both.

Control Logic

8707 - 173 on Service Card

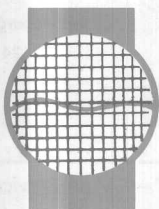
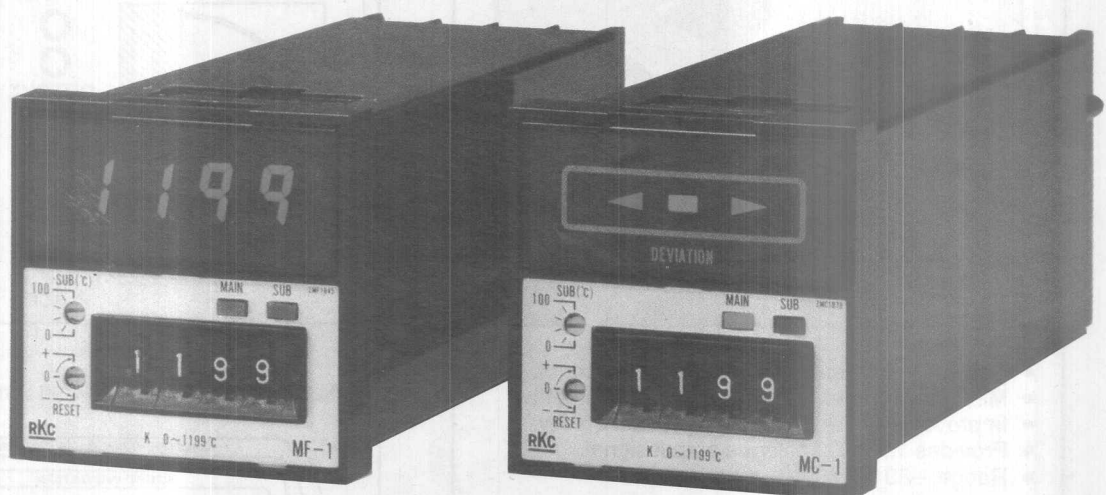
RKC[®]

The range of controllers specified by discerning Japanese engineers - now available to the discerning South African engineer.

The MF-1 Series "Mini" controllers from RKC are a typical example of the latest in hi-tech design and manufacture from Japan.

Just look at some of these features.

- * Compact DIN size 48mm x 48mm
- * Easy to read digital display
- * Precise digital setting
- * Thermocouple and PT100 inputs
- * Available with optional alarms
- * Plug-in construction for easy service
- * Economical



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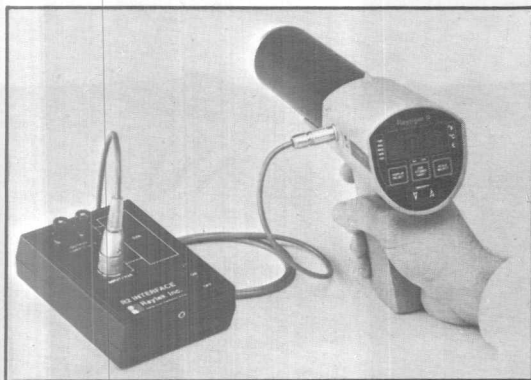
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Infrared Thermometry ... Your helping hand



- Pinpoints overheating before damage occurs.
- Measures temperatures of moving equipment.
- Improves process control and product quality.
- Provides 1mV/°C analogue output signal.
- Range: -30 to 1400°C.

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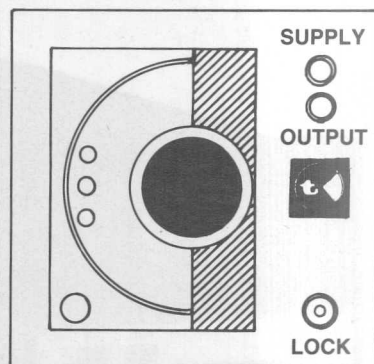
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8707 - 175 on Service Card



Tempatron

Temperature controllers



ACTUAL SIZE

- 48 × 48 mm
- Panel or surface mounting
- PD action
- Adjustable proportional band
- Lockable setpoint
- Deviation indication
- Most thermocouples or Pt 100's

ALSO AVAILABLE: 96 × 96 mm PID CONTROLLERS



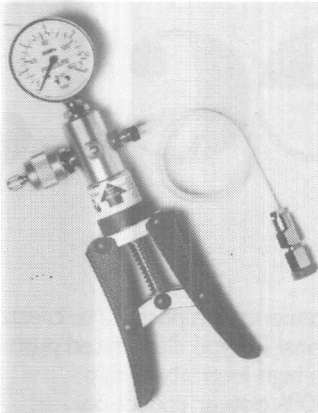
MACHINE & PROCESS CONTROL (011) 786-3275
SPEED INDICATION 4-30767
Box 51111
Raedene
Johannesburg
2124
8400489/07 (Pty) Ltd.
PRODUCTION RECORDING

8707 - 177 on Service Card

Portable pressure test unit

The need for 'on-the-spot' calibration checks by works or field service engineers has created the need for a lightweight and portable handheld test pump.

The new TPI handheld test pump, introduced by *Lucas Industrial Measurements*, combines a pressure source with a test gauge in a single unit.



The pump is a portable pneumatic source of either pressure or vacuum supply, capable of generating up to 2200 kPa pressure or 80 kPa vacuum. Designed for ease of operation, a selection of accurate ($\pm 1\%$ FSD) 'quick release' gauges is available to meet most application requirements.

The TPI handheld test pump is supplied in a light, high quality carrying case with standard accessories. *Negretti & Zambra*

8707 - 178 on Service Card

Electrochemical monitors

Designed for either pH/ORP or conductivity, *Foxboro* 872 monitors, with tactile feedback keypads, offer tough NEMA-4X housing, isolated and non-isolated outputs (0-10 V, 0/4-20 mA), analog temperature output, two alarm contacts and a NOVRAM memory. Alarms can be Hi/Lo, Hi/Hi or Lo/Lo settings adjustable over full scale according to keypad setting of configuration and levels.

Built-in microprocessor-based diagnostics monitor the total system performance and four-digit security code limits programming access to authorised personnel.

Curve generation programming produces conductivity-vs-concentration and conductivity-vs-temperature curves. Measurements of conductivity are possible from 0-1 $\mu\text{S}/\text{cm}$ to 0-2000 mS/cm and temperature compensation automatically corrects the reading for the fluid temperature.

A.F.H. Devers

8707 - 179 on Service Card

Infrared radiometer with data processor

Williamson's portable ThermoStar 22DS is designed for noncontact temperature measurement from 250-850 $^{\circ}\text{C}$ and has see-through aiming, internal and external digital displays, and a portable digital data logger.

The dual purpose instrument is lightweight, compact and user friendly. It can be used manually to measure and record data as a portable troubleshooting instrument or for continuous on-line monitoring.

Accuracy is 1%, repeatability $\pm 17^{\circ}\text{C}$ and adjustable response time is 0.10 to 5.0 s.

Temperature Controls

8707 - 180 on Service Card

Laser vibrometer

PCBs model 398A laser feedback vibrometer incorporates a laser tube and smart counter.

The counter has a Motorola 68000 16/32-bit microprocessor and can be operated either as a vibrometer or as a counter. In the vibrometer mode, the device calculates the frequency, displacement, velocity and acceleration of the vibrating object.

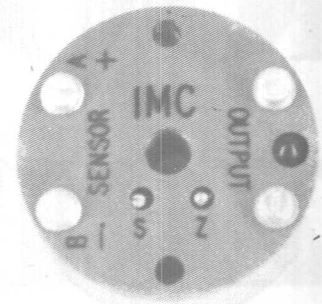
In its present configuration, a reference frequency is required to gate the smart counter making it best suited to periodic measurements.

In the counter mode, the model 398A measures either the frequency of input channels or the ratio between two channels. The frequency range is from 1 Hz to 5 MHz.

The Model 398A is a feedback

TWO-WIRE TEMPERATURE TRANSMITTERS

- SA Manufacture
- T.C. & RTD Models
- Low cost
- Linearisation optional
- Mounts in standard head
- Calibration Adjustable



Other South African made electronic instruments from our range include pH transmitters, vibration transmitters, signal converters, integrators, alarm/trip units and digital indicators etc.

IMC
instruments

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8707 - 182 on Service Card

Laser vibrometer (continued)

He-Ne laser, high-speed response photodetector with a wide band amplifier, laser support structure and accessories. The outputting light beam projects on a reflecting mirror or plated plastic membrane attached to the test object.

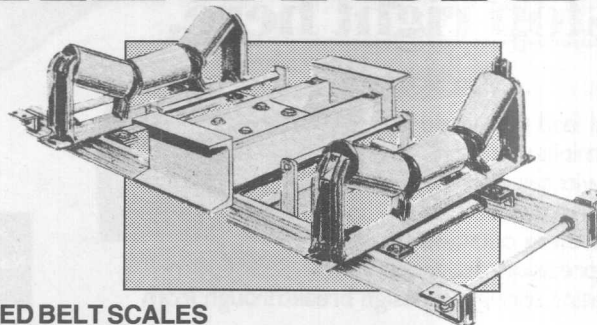
The vibrometer system can

measure a vibrating object 10 m away and has the advantage of being able to render data from vibrating objects in hostile environments where high temperatures and excessive noise might distort the data of a contact accelerometer.

Spescom TMS

8707 - 181 on Service Card

PRECISION



RUGGED BELT SCALES

FEATURES:

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- High accuracy
- Overload protection
- Local manufacture



BENEFITS:

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- Assize approved (SA 1082)
- Optimum loadcell selection
- Qualified after sales service

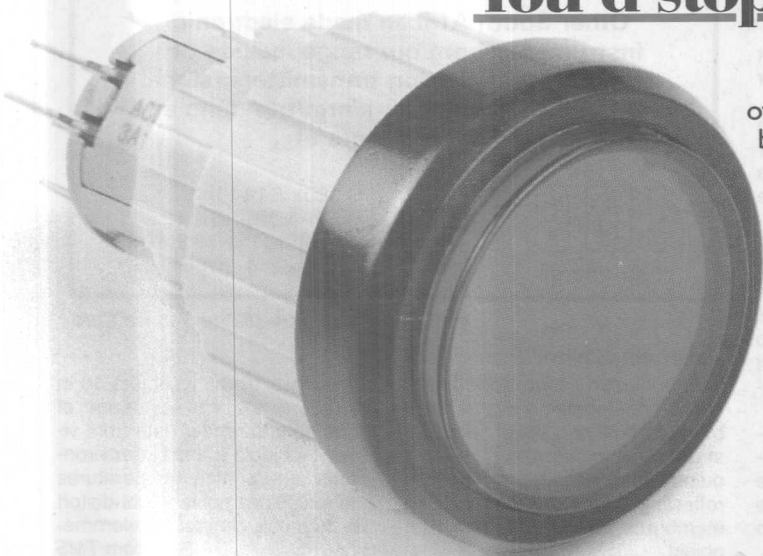
SA Automation (Pty) Ltd

P.O. Box 3172 Randburg 2125. Telephone: (011) 795-2077 Telex: 4-25394

8707 - 183 on Service Card

If you're looking for zero defect.

You'd stop right here.



Utilizing only 75 stock components, it is possible to create over 5 400 combinations of National D type illuminated push button switches. A feature is the high intensity 6-chip illuminating LED block with a 40% power reduction.

The range includes excellent waterproof and dustproof models. Elegant and economical to operate, and reliable. Could you ask for more?

You'd stop right here.

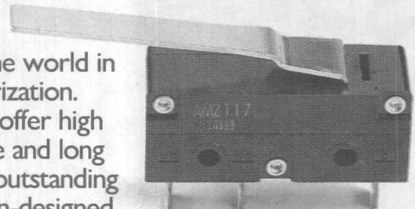


Our relays are backed by four decades of research. So it's no surprise they're the world's number one relay. The relays you can totally depend on.

The range is enormous. Hermetically sealed relays, compact and heavy duty power relays, subminiature relays,

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National lead the world in many areas of miniaturization. These micro switches offer high reliability, performance and long life. The key to these outstanding benefits is the precision-designed balanced operating spring – a design breakthrough from National.

Choose your micro switches from our extensive range.

 **National**
The quest for zero defect

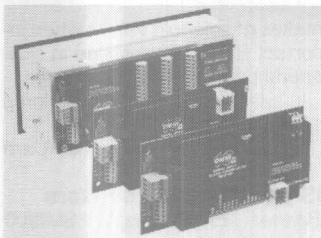
National Electro-mechanical components.

Telkor TELKOR SALES (011) 887-0410.

instrumentation

Serial input annunciator

Conlog's microprocessor-based annunciator, OMNI-16a, now offers an add-on terminal board which permits field data entry directly from Squeezer telemetry stations. This allows up to 64 alarms to be transmitted over a low cost twisted pair over a distance of up to 10 km to the OMNI-16a group where the annunciation will take place.



Communications failure on the serial line is indicated by using one window on the annunciator or the LED provided on the terminal board.

The OMNI-16a offers 27 standard built-in sequences and the serial input terminal board replaces the standard terminal board and may be purchased as an add-on or ordered with the OMNI-16a.

Control Logic

8707 - 185 on Service Card

Signal controller

The PC-captor, from Weber Sen-tec, is a universally applicable signal controller for all sensors that give a standardised voltage or current output and converts the sensor's analog output signal into a % value, in which the maximum current of 20 mA is equal to 100 % displayed as a three-digit value.

The PC-captor has two independent alarm setpoints selectable as Hi/Lo, Hi/Hi, or Lo/Lo. The three options may be selected by means of a DIP switch.

The setpoints are screwdriver adjustable and an external toggle switch allows the values to be digitally displayed.

A system failure alarm indicates failure by a red flashing LED, whilst relay contacts can be used to operate a remote alarm.

Designed for single sensor applications, the signal controller can be connected to any industrial 24 V d.c. supply.

Weil Electronics

8707 - 186 on Service Card

I/P converters

The type 100X/101X I/P converters from Watson Smith convert a standard 4-20 mA input signal into a 20-100 kPa (100X) or 14-800 kPa (101X) output.

Available in 2- or 3-wire versions all models incorporate an integral volume booster to provide flow rates up to 4.72 l/s.

An IS model is also available.

Action Instruments

8707 - 187 on Service Card

Head-mounting transmitters

The locally manufactured PTX series of transmitters, designed to mount into standard style thermocouple heads, conforming to the ANSI standard, are for use with PT100 (DIN 43760) sensors, with both standard and premium grades available, offering 0.2 % and 0.1 % accuracy respectively.

Only two wires are required to run from the instrument being used, to the sensor, as a power supply runs in series with the output of 4-20 mA d.c. Power indication is by a red LED, with reverse polarity fitted as standard.

Response time is 50 ms to within 0.1 % of final output. Minimum output current is 3.5 mA d.c. with ambient operating temperature of -30 to 70 °C. The unit incorporates RFI protection at 2 W - 150 MHz.

TCL Devices

8707 - 188 on Service Card

Digital temperature/process controllers

Sigma Controls have two new microprocessor controller additions to their range. The MDC5 unit is a 48 x 96 mm self tuning controller for temperature, with full PID control action. Both the range and control parameters of this compact unit can be changed by use of internal DIL switches. Output options include mA, voltage, relay, zero cross firing, and d.c. voltage pulse.

The MDC10-08 type 'B' unit has been added to the already extensive range of 96 x 96 mm controllers and has the facility for the control of a servo mechanism, such as a motorised valve which does not have feedback potentiometer. Auto/manual is fitted as standard, as well as self tuning, and full PID control action. Main control is by way of two change-over relays operating open and close windings of the motorised valve. The unit also has adjustable extra high and low alarms and relay output.

Rostav Instrumentation & Electronics

8707 - 189 on Service Card

Mini-sized temperature controllers

RKC has introduced a new series of mini-sized temperature controllers which are ideal for use on small machines. Measuring only 48 x 48 mm, the units offer a 4-digit scale range with an optional alarm function. Two types are available, the MC-1 of deviation indicating type and the MF-1, a digital display type.

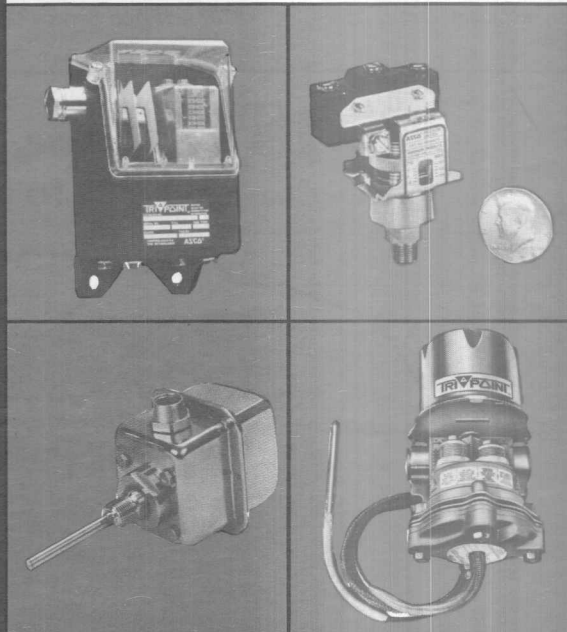
Setting accuracy with thermocouple input is better than ± 1.5 % and with RTD input, better than ± 1.0 %.

Temperature Controls

8707 - 190 on Service Card

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Pressure or Temperature Switches for Industrial or O.E.M. use, off the shelf



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P.O. Box 750, Westville 3630.
Tel: (031) 86-7259

8707 - 191 on Service Card

BLI-9

control

Inductive proximity sensor

Weber's range of 'Proxi-captors', contactless inductive proximity switches with adjustable sensing distances, is designed for installation in harsh industrial environments.

Contained in a Noryl plastic case, the internal electronics are completely encapsulated in epoxy resin. The sensing distance is adjustable by a screw potentiometer and the switching mode is indicated by a red LED function indicator.

A nylon fixing bolt permits rapid and simple installation. Should an accident occur, and

the Proxi-captor is struck, the nylon will break, thereby protecting the unit from physical damage.

As an alternative, Proxi-captors can be supplied with aluminium mounting plates.

For higher operating temperatures, water cooled versions are available.

All Weber Proxi-captors, with the exception of type 2040, are available with an optional built-in circuit, providing remote activation for test purposes.

Weil Electronics

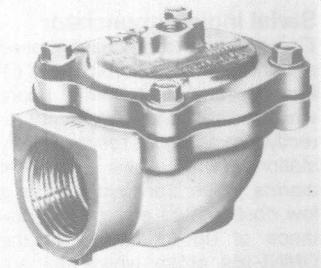
8707 - 192 on Service Card

Quick exhaust shuttle valves

Three ported valves, designed with oversized exhaust orifices, allow quick exhaust of cylinders, diaphragms, brakes, clutches, etc. and allow use of smaller pipe lines and control components where an application requires quick venting. Another feature is their versatility as shuttle valves. A shut-off construction is also available.

The valves fit pipe sizes of 3, 6, 12, 15, and 20 mm NPT. The valve body and bonnet are die-cast zinc while the valve seat is a Buna 'N' diaphragm. They operate in a maximum fluid and ambient temperature of 51 °C.

The valves are mountable in any position without affecting operation and can be used with any



makes of solenoid valves when incorrect sizing has resulted in slow operation of main control valves.

Ascoreg

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IS photoelectric sensors

Banner Engineering's SMI900 range of photoelectric sensors is rated for safety division one classes 1, 11 and 111, groups A, B, C, D, E and G, also for non-incendive division 2 classes 1, 11 and 111, groups A, B, C, D and G.

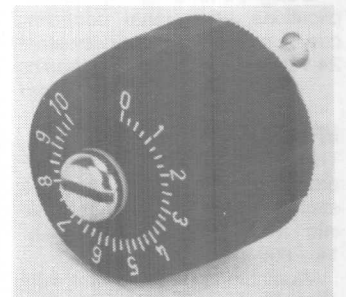
Division 1 use of the SMI900 series sensors requires inclusion of safety barriers. Used within division 2, the sensors may be operated without barriers.

The SMI900 series is available in four scanning modes: retro-reflective, diffuse (proximity), through beam, and fibre-optic. D.c. powered (10-30 V), two or three wire operation with current-sink output, sensitivity adjustment, and light/dark operation selection is standard on all models.

RET Automation Controls
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Precision flow control valve

Festo have introduced a precision flow control valve to their existing range which provides precise adjustment and reproducibility of flow valves with compressed air, neutral gases, and liquids. Long-term security for the flow-valve setting is ensured by a lockable rotary knob and a convenient characteristic curve, and small adjustment angle, allow varying flow rates to be set rapidly and reliably.

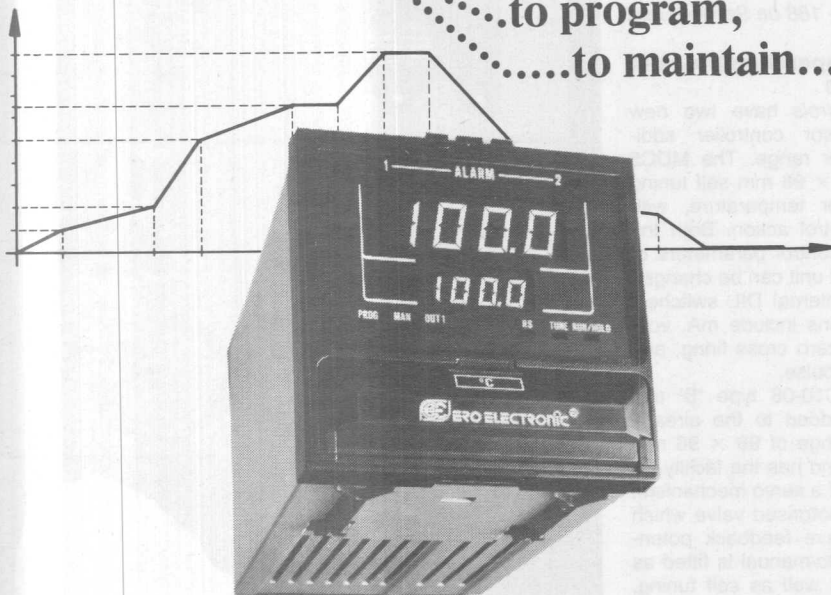


A wide variety of mounting methods is possible: on front panels, in control cabinets, on mounting brackets, and on integrated blocks

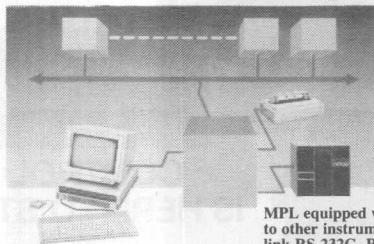
Festo

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Easy to use,
to program,
to maintain...



... these facilities can mean a lot for a programmer/controller.



Choose MPL µPro based instrument, flexible, configurable, linkable with computer.

Unique features:

- Universal inputs - Keyboard configurable.
- 6 patterns can be stored, 16 segments each.
- Dual programmable alarms: band - deviation - process.
- STOP - RUN - HOLD operations by front pushbuttons or by closing/opening a mechanical contact on terminal block.
- Set point tracking function (when process variable is higher than set point starting up).

MPL equipped with serial communication interface can talk to other instruments, computer, printer, by using interface link RS 232C, RS 422 and RS 485.

The input circuit is designed to accept all INPUTS, such as:

- Thermocouples J-K-R-S-T-E-B in °C or °F (IEC 584).
- RTD Pt100 Ohm (DIN 43760).
- Linear: 0 - 20 mA, 4 - 20 mA, 0 - 10 V d.c., 1 - 5 V d.c.

OUTPUTS:

- Time proportioning: with relay or V d.c.
- Linear: 0 - 20 mA or 4 - 20 mA.
- Valve motor drive: for closed loop servomotor. Low/High limits, span and dead band programmable.
- Heating/Cooling: relay, Volt and linear.



ERO ELECTRONICS SOUTH AFRICA (PTY) LTD

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Box 34515 Jeppestown 2043 South Africa

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Seeing, sensing, switching

It makes sense to switch to Countapulse Controls for accurate, reliable, maintenance-free **LEUZE** scanners, thru-beam or reflex light barriers with switching distances from 3 mm – 30 m and AC- and DC- **PULSORS** and **FLEXORS** from **PULSOTRONIC** which operate against any metal target over switching distances of 1–70 mm.

A large range of different models are available ex stock, countrywide — from the people that count.



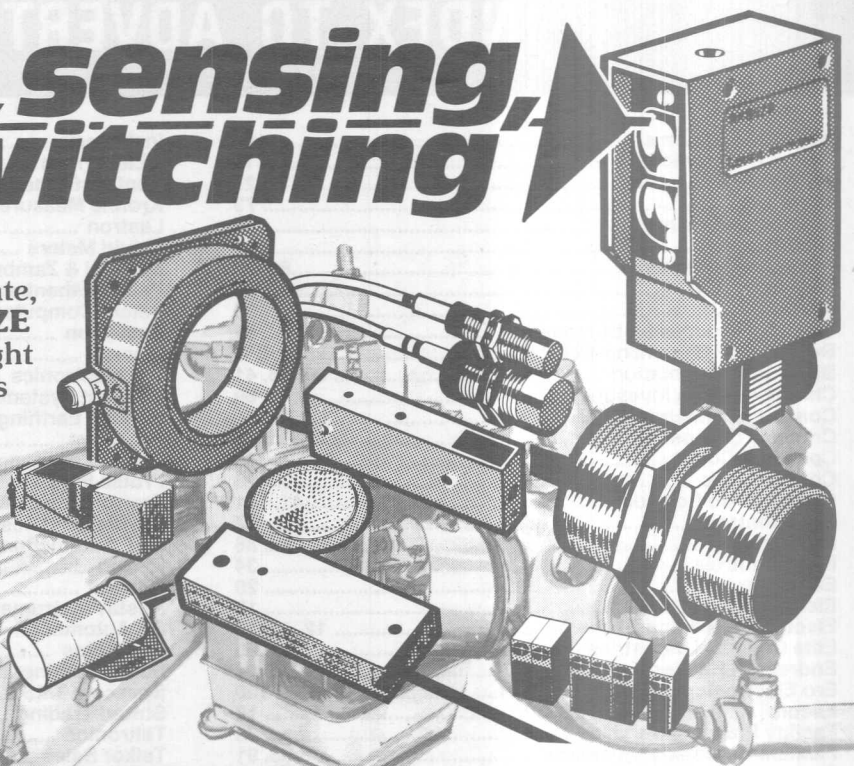
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(PTY.) LTD. Johannesburg (011) 615-7556

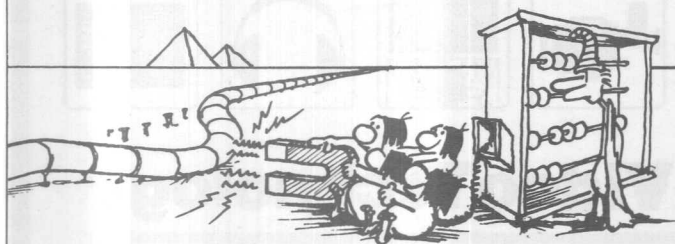
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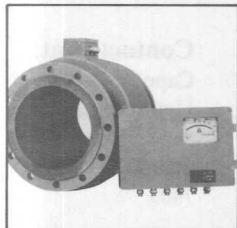
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“There are still some people not using Turbomesstechnik magnetic flowmeters”



Heath Robinson type flowmeasuring devices are all very well, but they're no match for a non-invasive Turbomesstechnik magnetic flowmeter. Available in sizes from 8 mm – 2 000 mm they are ideal for slurries and pulps, and provide an extremely high measuring accuracy, particularly at low flow rates.



Liquid Meters

(Previously S.A. Liquid Meters)

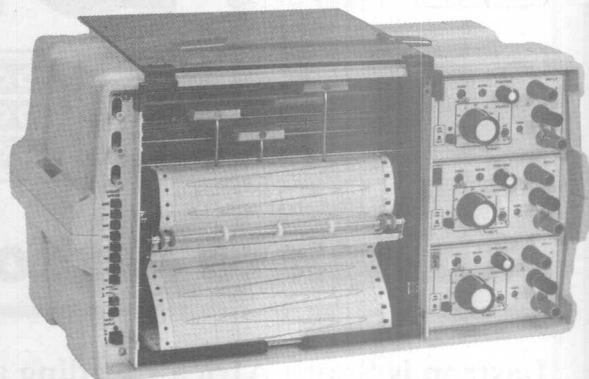
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Tel: (011) 974-5235

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PORTABLE CHART RECORDERS



Full scale 1 mV to 500V.
1, 2, 3 Independent channels.
Chart speed 1 cm/sec. to 1 cm/hr.
Roll or Z-fold 150 mm charts.
Battery or mains.

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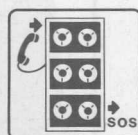
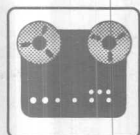
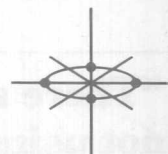
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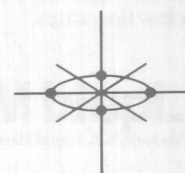
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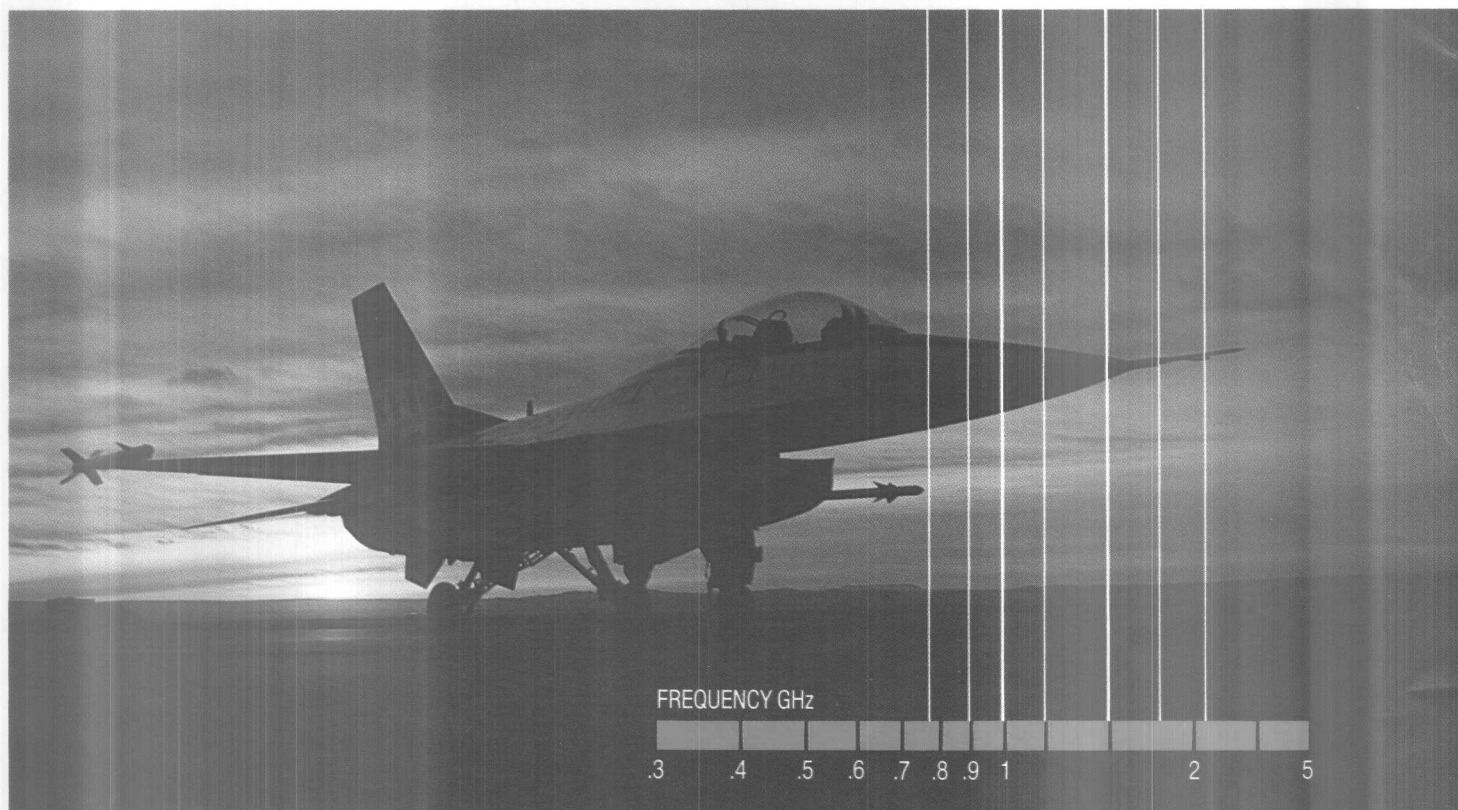
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In your frequency range, but not out of your price range.



Introducing the first high-performance 2 GHz signal generator that sets new standards in price/performance.

If you're expanding your testing capabilities in the up to 2 GHz range, or updating older equipment, our new 6062A offers an outstanding value. With high accuracy, low noise signals, and AM, FM and PM modulation, this new synthesized signal generator keeps the price of quality production testing surprisingly low.

The 6062A is the only signal generator in its price range that also offers high-speed pulse modulation as a standard feature. So you can test radar and avionics transponders without paying a premium. Very high on-to-off ratios (80 dB minimum) and very

fast rise times (15 ns) are made possible by new gallium arsenide switching technology.

For low-cost convenient maintenance, you can do on-site calibration yourself — manually or over the IEEE bus. The 6062A is based on the highly reliable 6060B, proven in thousands of installations at manufacturing facilities worldwide. And like all Fluke instruments, the 6062A is backed by Fluke service, training and our exclusive fast-turnaround modular exchange program for emergency repairs.

Contact your local Fluke Sales Engineer or call any of the PNI Test Systems offices listed below. High performance is now in your frequency range. And in your price range.



Fluke 6062A

Frequency Range	100 kHz to 2100 MHz
Amplitude range	-147 to +13 dBm
Spurious	-60 dBc (to 1050 MHz)
Residual FM (500 MHz)	6 Hz in 0.3 to 3 kHz BW
Modulation	AM, FM, PM, pulse



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Ken Hirschberg & Associates 4771

The next step forward

New Sales Manager Appointed

The 1st June 1987 saw the appointment of Mr Theunis Kruger as Johannesburg Area Sales Manager.

Theunis, aged 31, who joins Hartmann & Braun from AFH Devers is well-known in the industry and was in the earlier days the youngest ever instrument superintendent to be appointed by ISKOP.



R1 Billion Sales in 1986

Hartmann & Braun again produced record results in 1986 with worldwide sales in excess of R1 billion. This increased turnover was achieved despite poor trading conditions in most areas. Major orders were received from most industrial sectors including the Chemical, Petro-chemical, Iron & Steel and Cement Industries as well as Power Stations and Industrial Power Plants. The company employs over 7 000 people and is represented either by subsidiary companies or distributors in over 50 countries.

NEW TELEPHONE NUMBER



Nothing can stand in the way of progress and so it is with the telephone systems. Thanks to the opening of new exchange facilities in Johannesburg the telephone number of Hartmann & Braun has been changed.

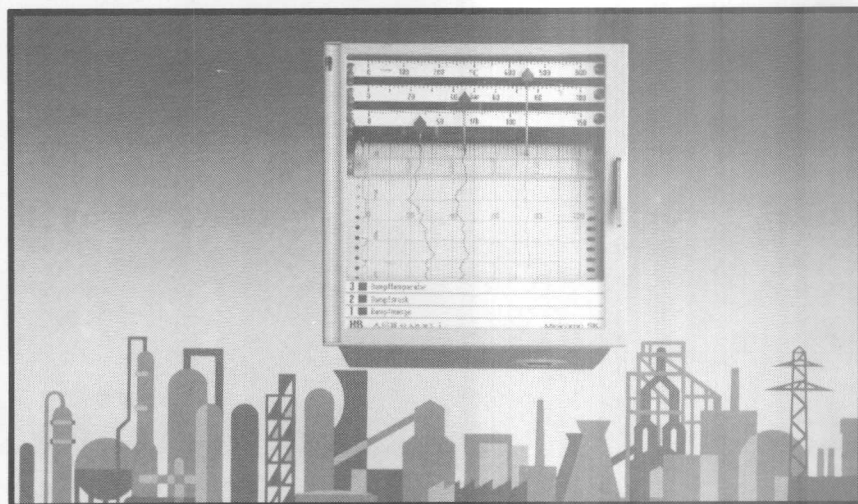
From 26 June 1987 please call

(011) 472-1340

Hartmann & Braun

P.O. Box 5912, Johannesburg 2000.

Hartmann & Braun has taken the next step forward along the path laid down when they purchased the old PCI company in 1984.



Agencies discarded

At the time of the take-over the company represented almost 90 overseas companies, selling a wide range of electrical goods and accessories.

During the last three years most of these agencies were cancelled allowing the company to concentrate on marketing its own well-known range of products. The success of this policy can be seen from the fact that sales have tripled in the last three years despite the cancelling of most of the agencies.

However, one final step was necessary — for several years Hartmann & Braun held the sole distributorship for the range of Camille Bauer recorders and indicators. The terms of this distributorship prohibited the sale in South Africa of the highly competitive range of recorders and indicators, manufactured by Hartmann & Braun themselves. With the expiry of this agreement Hartmann & Braun is now able to introduce its own products to the South African market — products which have over the years proved extremely successful in other countries.

Recorder range

A comprehensive range of both pen and

dotting recorders is being introduced. These recorders offer many features not previously available, for example, the new Arucomp SK, 6 channel recorder has on board programming, so that range changing is extremely simple, a built-in alpha numeric printer which is also programmable as well as an optional digital indicator to replace the standard analogue presentation.

A catalogue giving full details of the whole range of recorders is available.

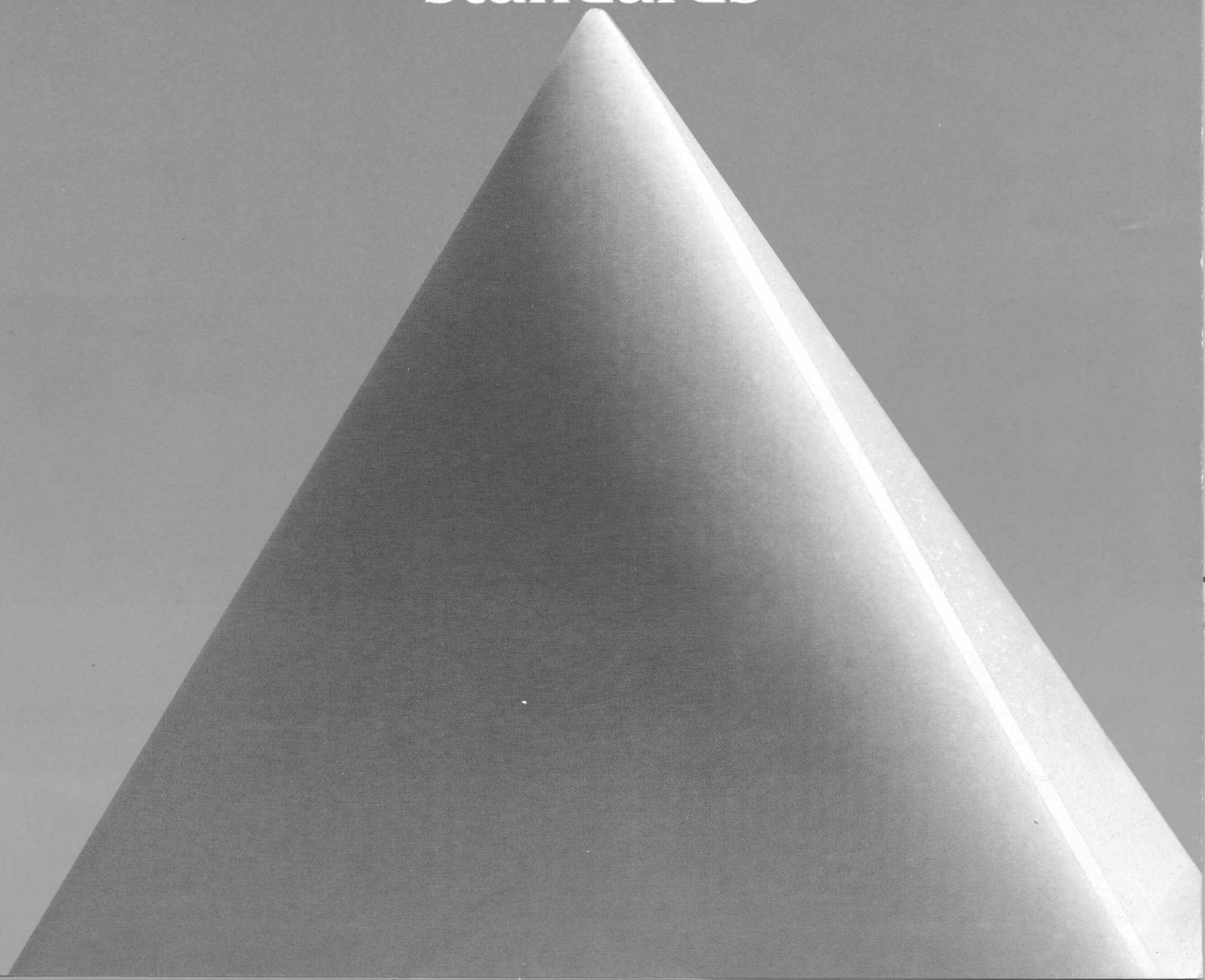
Choice of indicators

A wide choice is offered by the new range of indicators being introduced. Three types of indicators are available in the 144x36mm format. Standard analogue, LCD or fluorescence indicators are available with a wide selection of measuring ranges and of course alarm options.

Service and spares

A full service and spares facility for these new products is already available at the company's Johannesburg factory and as an ongoing service to its customers the company will continue to service and provide spares for the Camille Bauer range of products even though they will no longer be distributing these instruments.

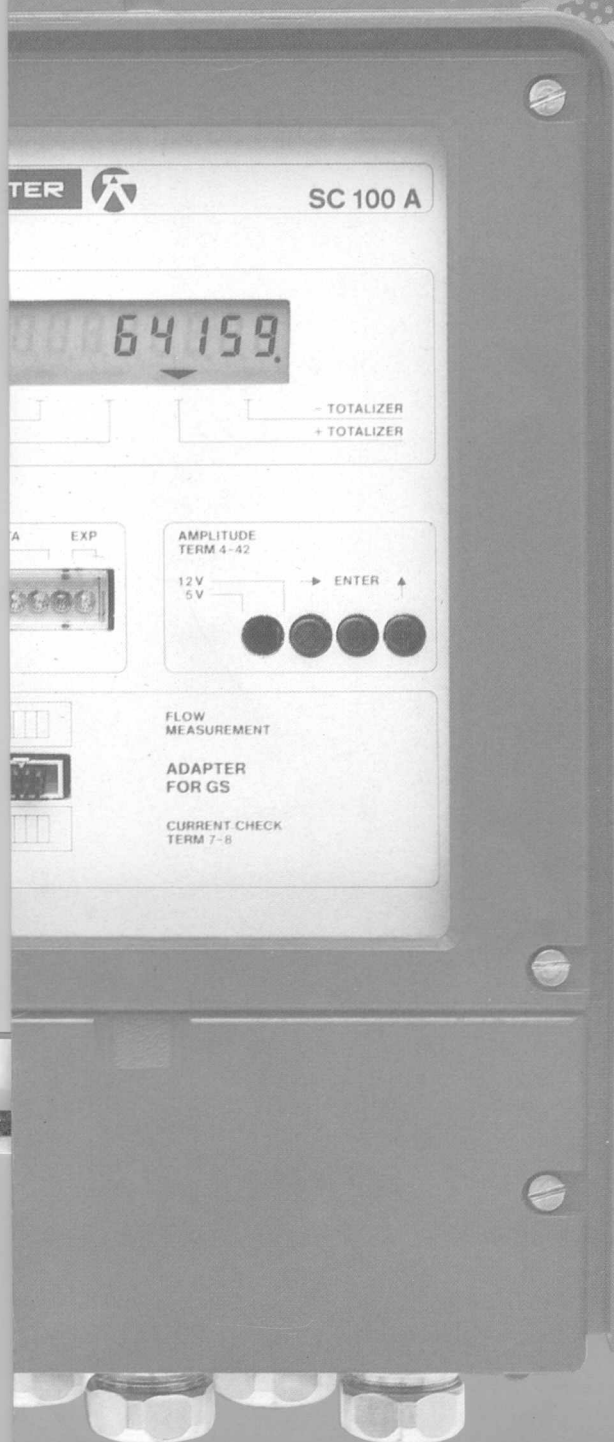
We set
new
standards



SC100



The new Dimension in Flow Measurement!



Digital Signal and Data Processing by Microprocessor opens up new Dimensions for magnetic inductive Flowmeters.

- ☐ **OUTSTANDING ACCURACY**
using high-resolution A/D-converter.
- ☐ **EXCELLENT LONG-TERM STABILITY**
as a result of the latest thin film techniques.
- ☐ **STANDARD FEATURES**
scaled pulse output, low-flow suppression, range change automatic and forward/reverse flow have been economically combined as standard equipment.
- ☐ **USER-FRIENDLY**
operator convenience by simple data input, no programming knowledge required to commission or re-programme.
- ☐ **UNIVERSAL OPERATION**
with programmable parameters such as time constant, magnetic field frequency and primary head constant.
- ☐ **LONG-TERM DATA STORAGE**
for minimum of 10 years without auxiliary power.

Krohne sets new standards for measuring techniques

KROHNE



Krohne revolutionized magnetic flowmetering techniques!



FIRST

— to introduce the magnetic flowmeters to the industrial markets.

FIRST

— to introduce the pulsed DC field excitation for primary heads.

FIRST

— to introduce the aluminium oxide measuring tube.

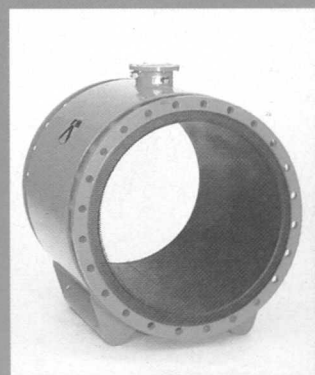
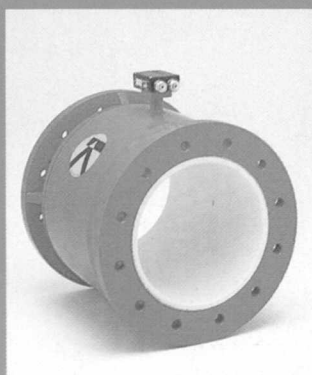
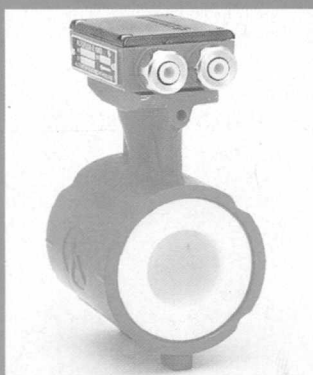
FIRST

— to offer a complete family of magnetic flowmeters — from 2 mm to 3 000 mm diameter with well over 100 000 in service today.

AND NOW

— the combination with the new SC 100 with all its advantages.

SURELY IT'S NOT EXAGGERATED TO SAY THAT KROHNE IS THE MAGFLOWMETER INNOVATOR



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